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FIG. 1

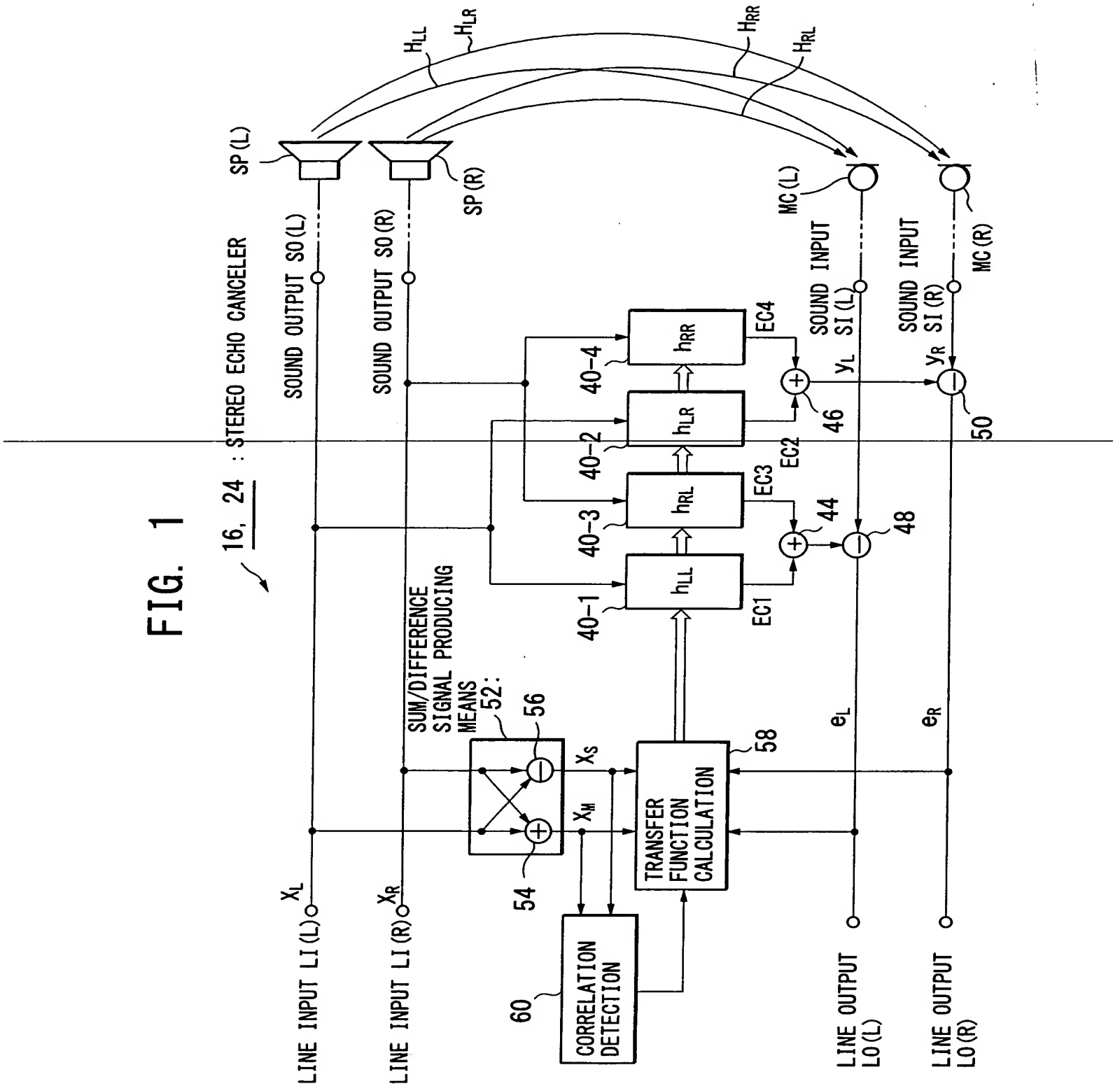

16, 24 : STEREO ECHO CANCELER
SP (L)
SP (R)
H_{LL}
H_{LR}
H_{RR}
H_{RL}
MC (L)
MC (R)
SOUND OUTPUT SO (L)
SOUND OUTPUT SO (R)
SOUND INPUT SI (L)
SOUND INPUT SI (R)
y_L
y_R
h_{LL}
h_{LR}
h_{RL}
h_{RR}
40-1
40-2
40-3
40-4
EC1
EC2
EC3
EC4
44
46
48
50
SUM/DIFFERENCE SIGNAL PRODUCING MEANS 52:
54
56
X_S
X_M
58
TRANSFER FUNCTION CALCULATION
e_L
e_R
60
CORRELATION DETECTION
X_L
X_R
LINE INPUT LI (L)
LINE INPUT LI (R)
LINE OUTPUT LO (L)
LINE OUTPUT LO (R)

FIG. 2

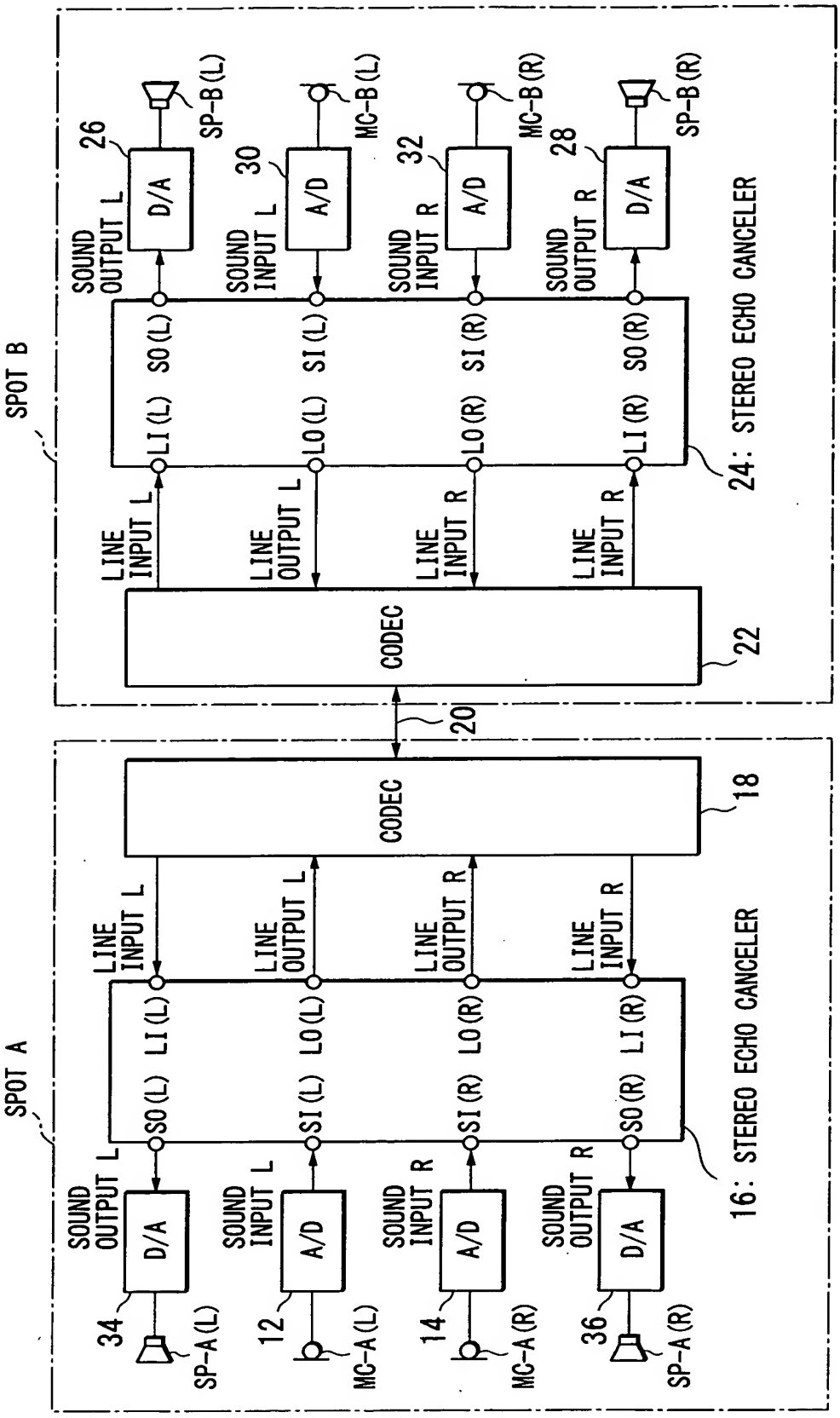

SPOT A
SPOT B
CODEC
22
CODEC
18
20
LINE INPUT L
LINE OUTPUT L
LINE OUTPUT R
LINE INPUT R
LI(L)
SO(L)
LO(L)
SI(L)
LO(R)
SI(R)
LI(R)
SO(R)
16: STEREO ECHO CANCELER
24: STEREO ECHO CANCELER
SOUND OUTPUT L
SOUND INPUT L
SOUND INPUT R
SOUND OUTPUT R
D/A
A/D
A/D
D/A
34
12
14
36
26
30
32
28
SP-A(L)
MC-A(L)
MC-A(R)
SP-A(R)
SP-B(L)
MC-B(L)
MC-B(R)
SP-B(R)

FIG.3

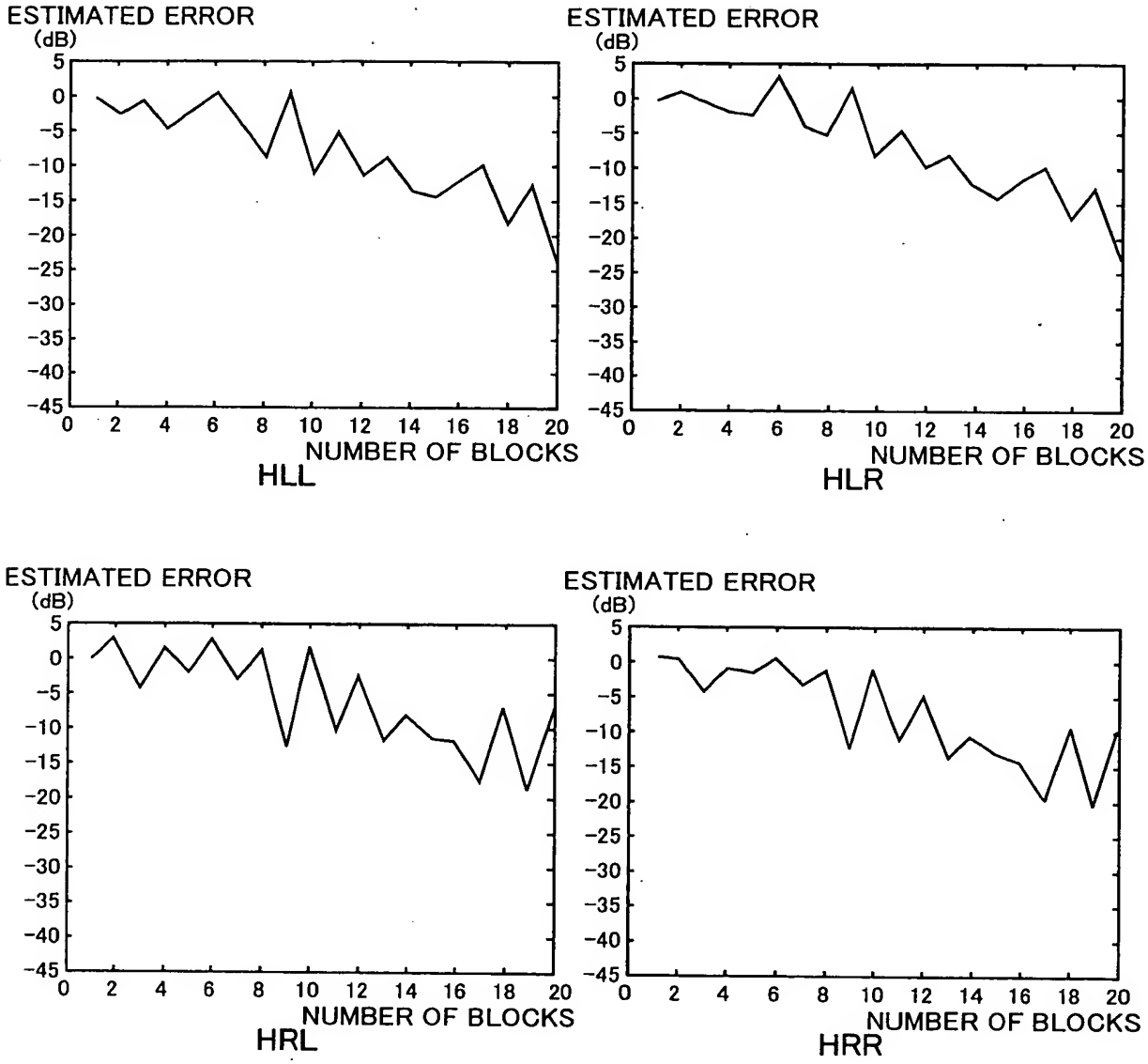

ESTIMATED ERROR
(dB)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
0 2 4 6 8 10 12 14 16 18 20
NUMBER OF BLOCKS
HLL
ESTIMATED ERROR
(dB)
NUMBER OF BLOCKS
HLR
ESTIMATED ERROR
(dB)
NUMBER OF BLOCKS
HRL
ESTIMATED ERROR
(dB)
NUMBER OF BLOCKS
HRR

FIG.4

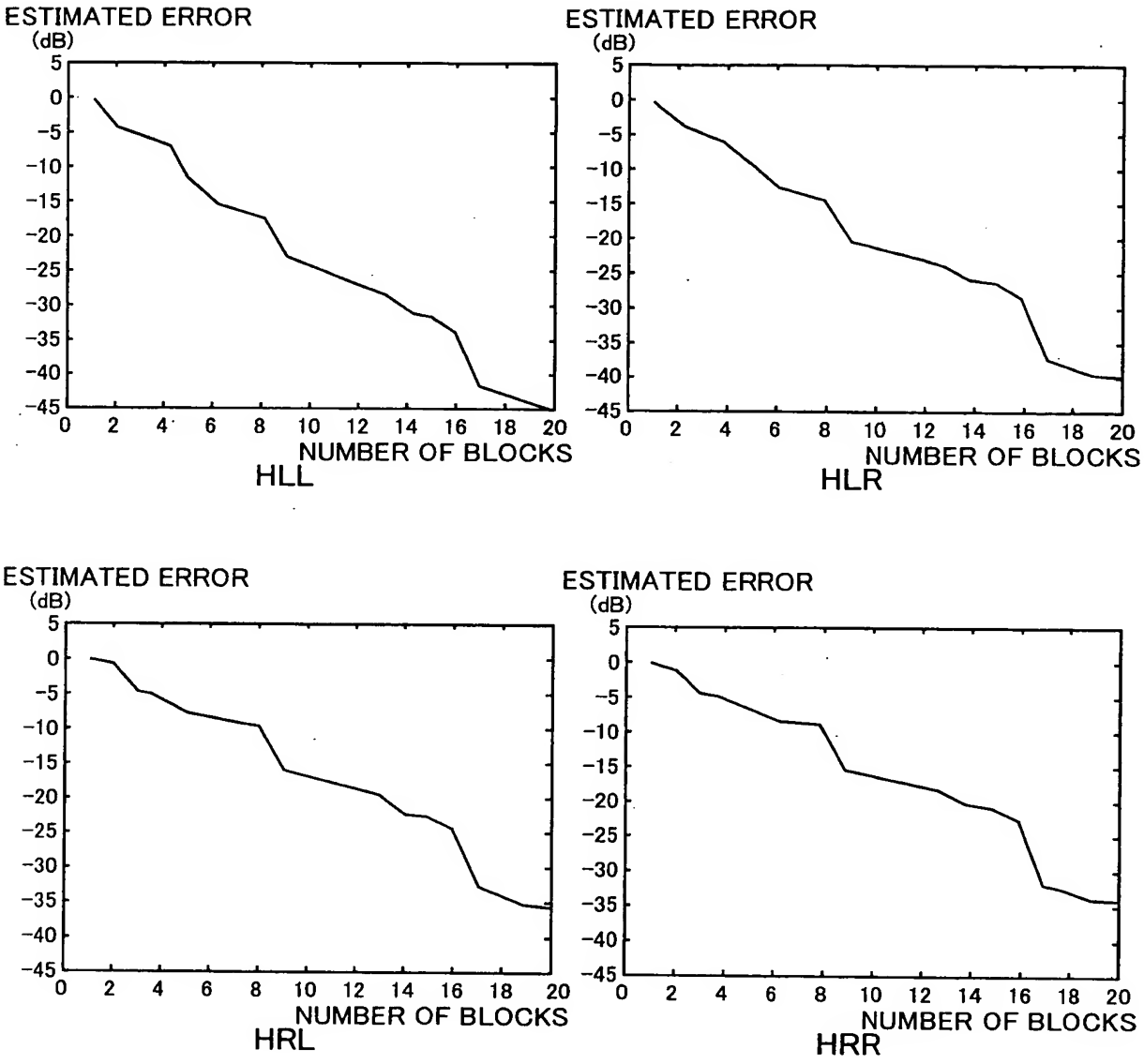

ESTIMATED ERROR
(dB)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
0 2 4 6 8 10 12 14 16 18 20
NUMBER OF BLOCKS
HLL
ESTIMATED ERROR
(dB)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
0 2 4 6 8 10 12 14 16 18 20
NUMBER OF BLOCKS
HLR
ESTIMATED ERROR
(dB)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
0 2 4 6 8 10 12 14 16 18 20
NUMBER OF BLOCKS
HRL
ESTIMATED ERROR
(dB)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
0 2 4 6 8 10 12 14 16 18 20
NUMBER OF BLOCKS
HRR

FIG.5

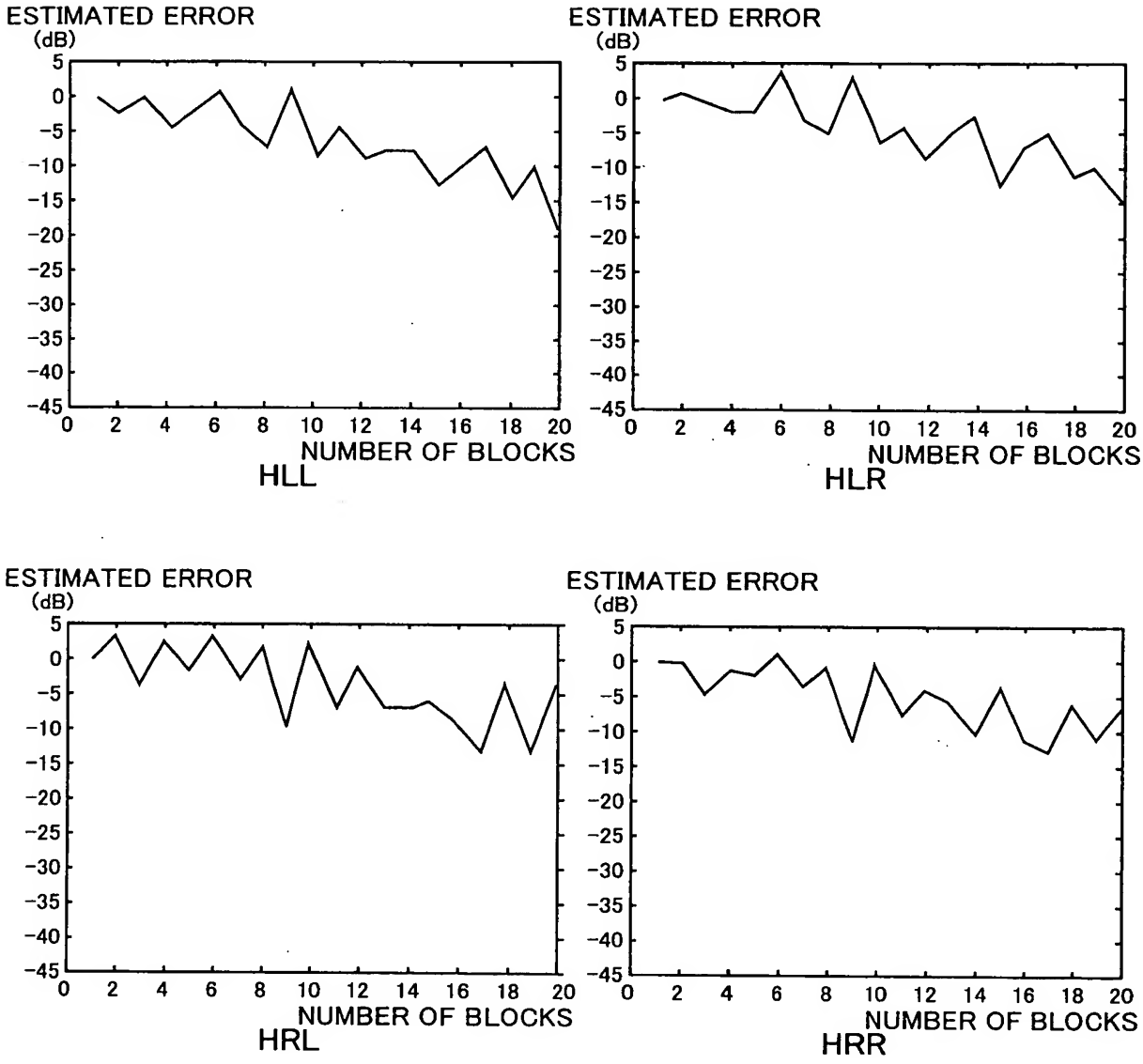

ESTIMATED ERROR
(dB)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
0 2 4 6 8 10 12 14 16 18 20
NUMBER OF BLOCKS
HLL
ESTIMATED ERROR
(dB)
NUMBER OF BLOCKS
HLR
ESTIMATED ERROR
(dB)
NUMBER OF BLOCKS
HRL
ESTIMATED ERROR
(dB)
NUMBER OF BLOCKS
HRR

FIG.6

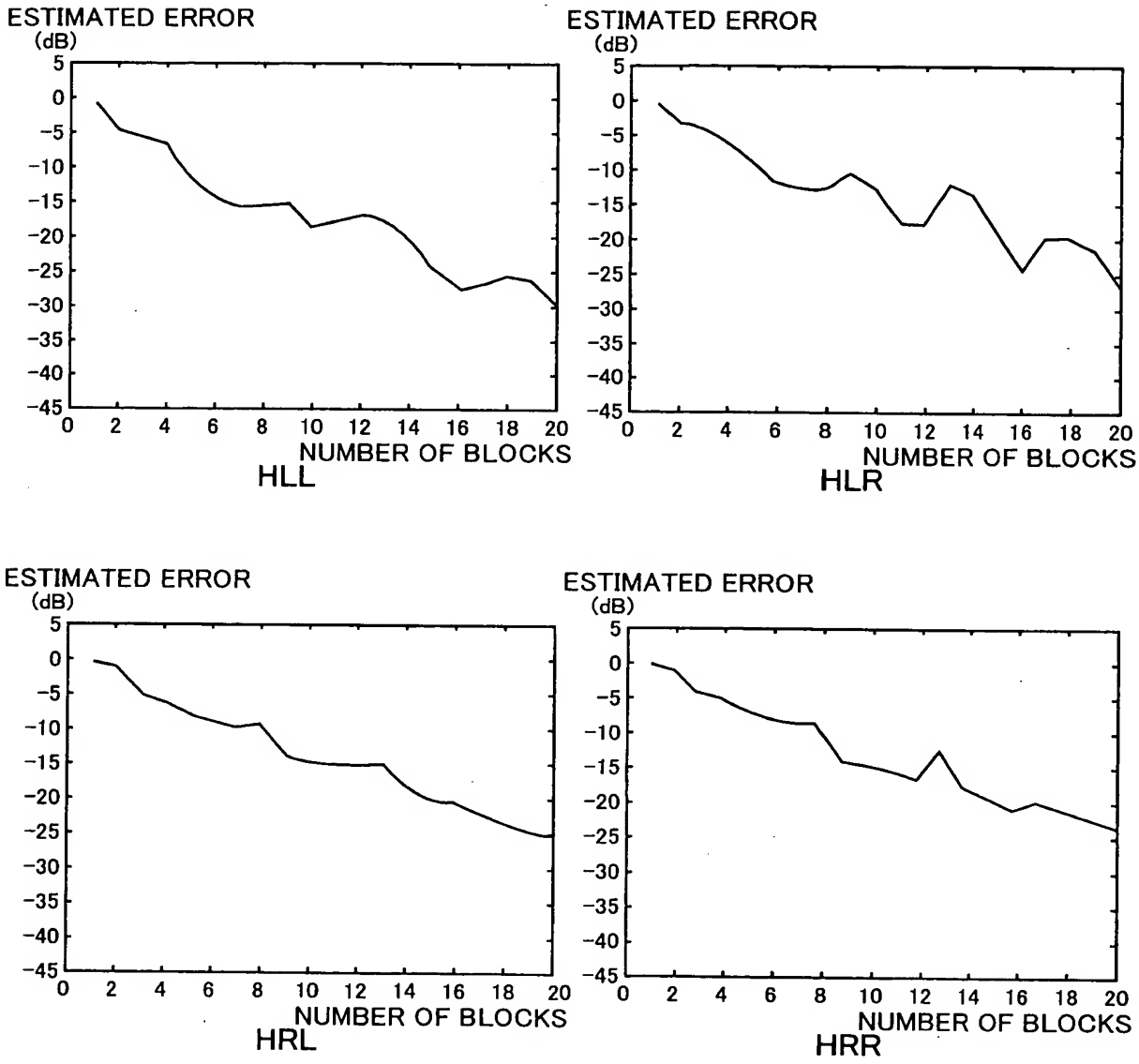

ESTIMATED ERROR
(dB)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
0 2 4 6 8 10 12 14 16 18 20
NUMBER OF BLOCKS
HLL
ESTIMATED ERROR
(dB)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
0 2 4 6 8 10 12 14 16 18 20
NUMBER OF BLOCKS
HLR
ESTIMATED ERROR
(dB)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
0 2 4 6 8 10 12 14 16 18 20
NUMBER OF BLOCKS
HRL
ESTIMATED ERROR
(dB)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
0 2 4 6 8 10 12 14 16 18 20
NUMBER OF BLOCKS
HRR

FIG.7

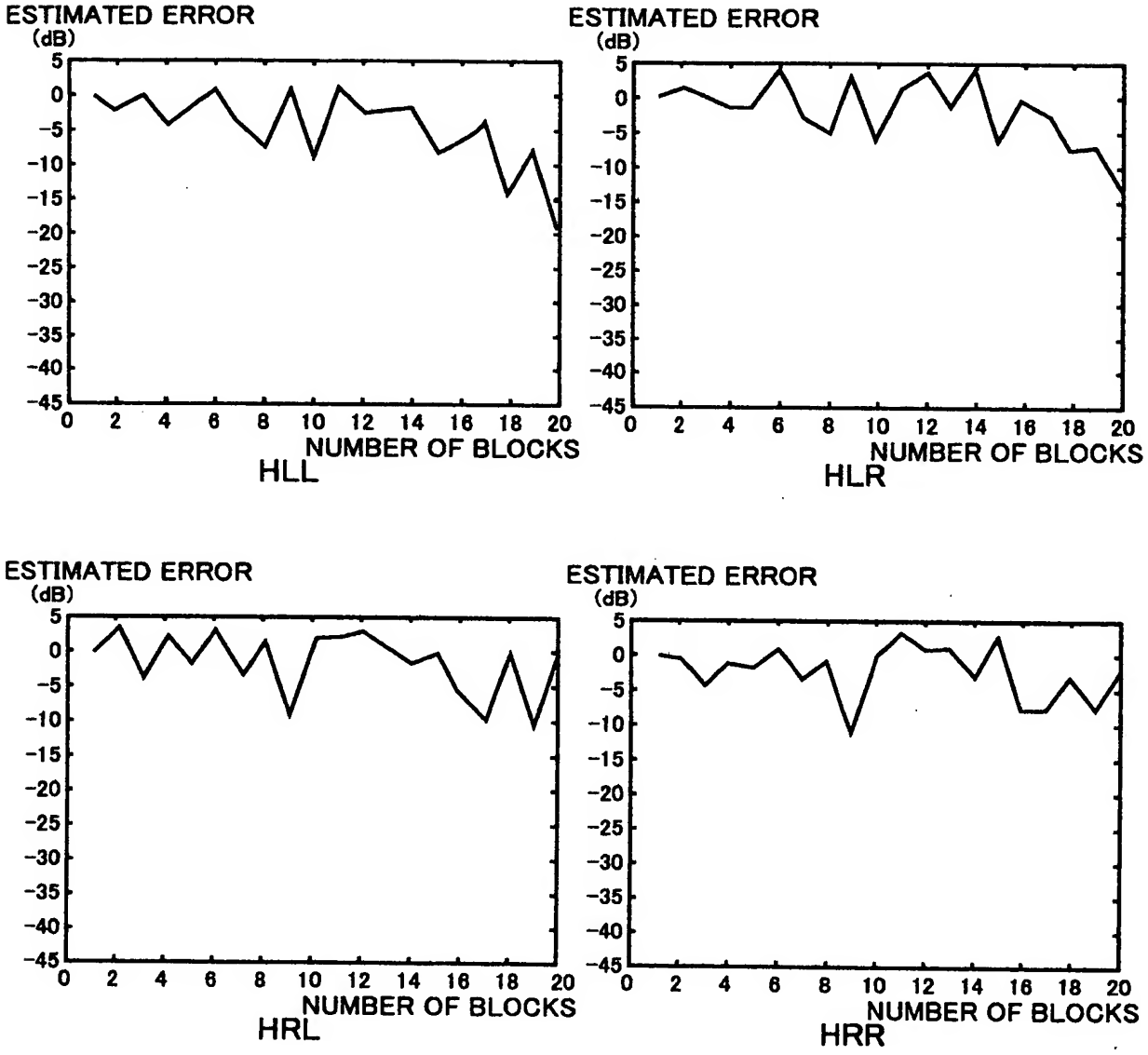

ESTIMATED ERROR
(dB)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
0 2 4 6 8 10 12 14 16 18 20
NUMBER OF BLOCKS
HLL
ESTIMATED ERROR
(dB)
NUMBER OF BLOCKS
HLR
ESTIMATED ERROR
(dB)
NUMBER OF BLOCKS
HRL
ESTIMATED ERROR
(dB)
NUMBER OF BLOCKS
HRR

FIG.8

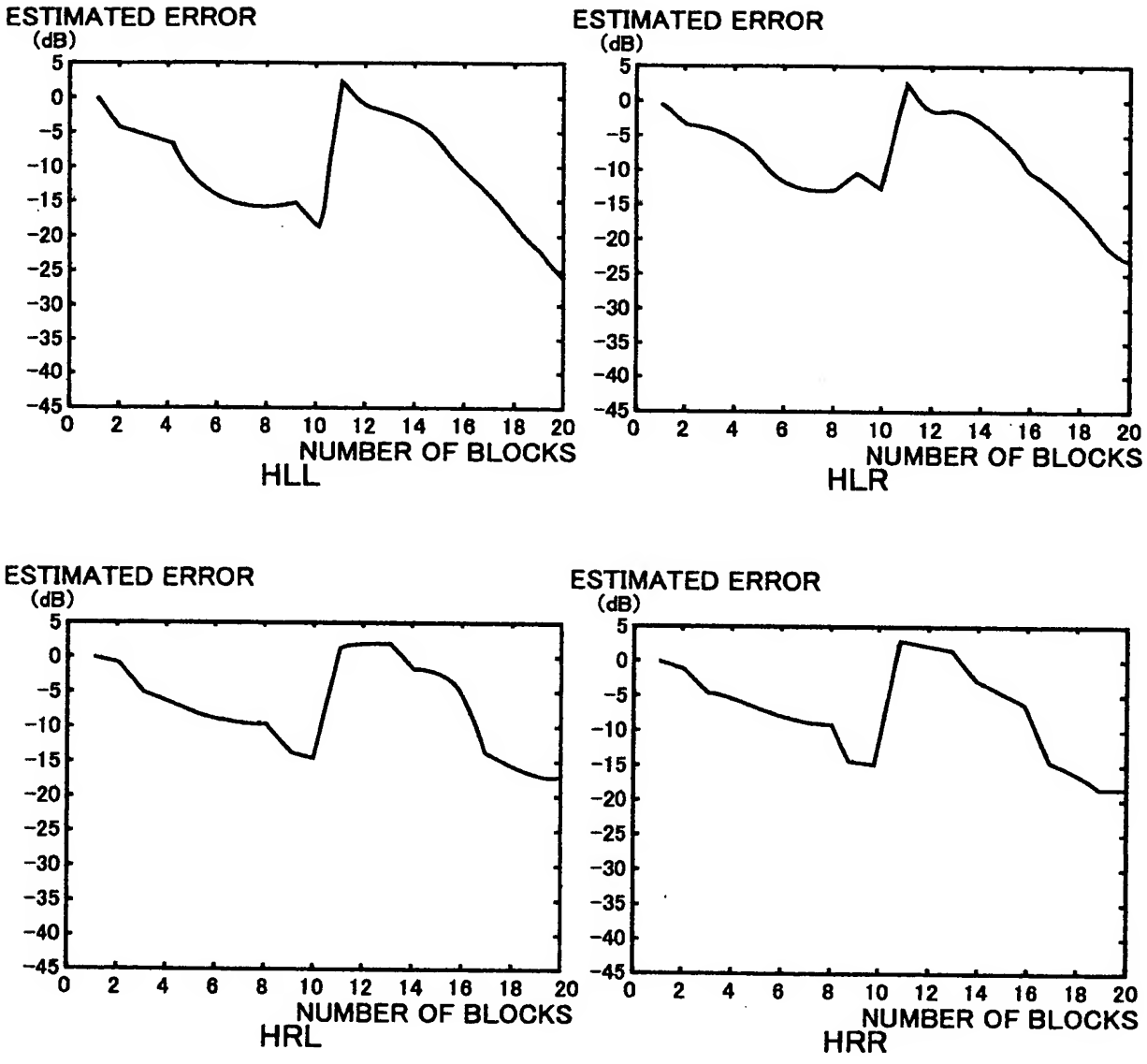

ESTIMATED ERROR
(dB)
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
0 2 4 6 8 10 12 14 16 18 20
NUMBER OF BLOCKS
HLL
ESTIMATED ERROR
(dB)
NUMBER OF BLOCKS
HLR
ESTIMATED ERROR
(dB)
NUMBER OF BLOCKS
HRL
ESTIMATED ERROR
(dB)
NUMBER OF BLOCKS
HRR

FIG. 9

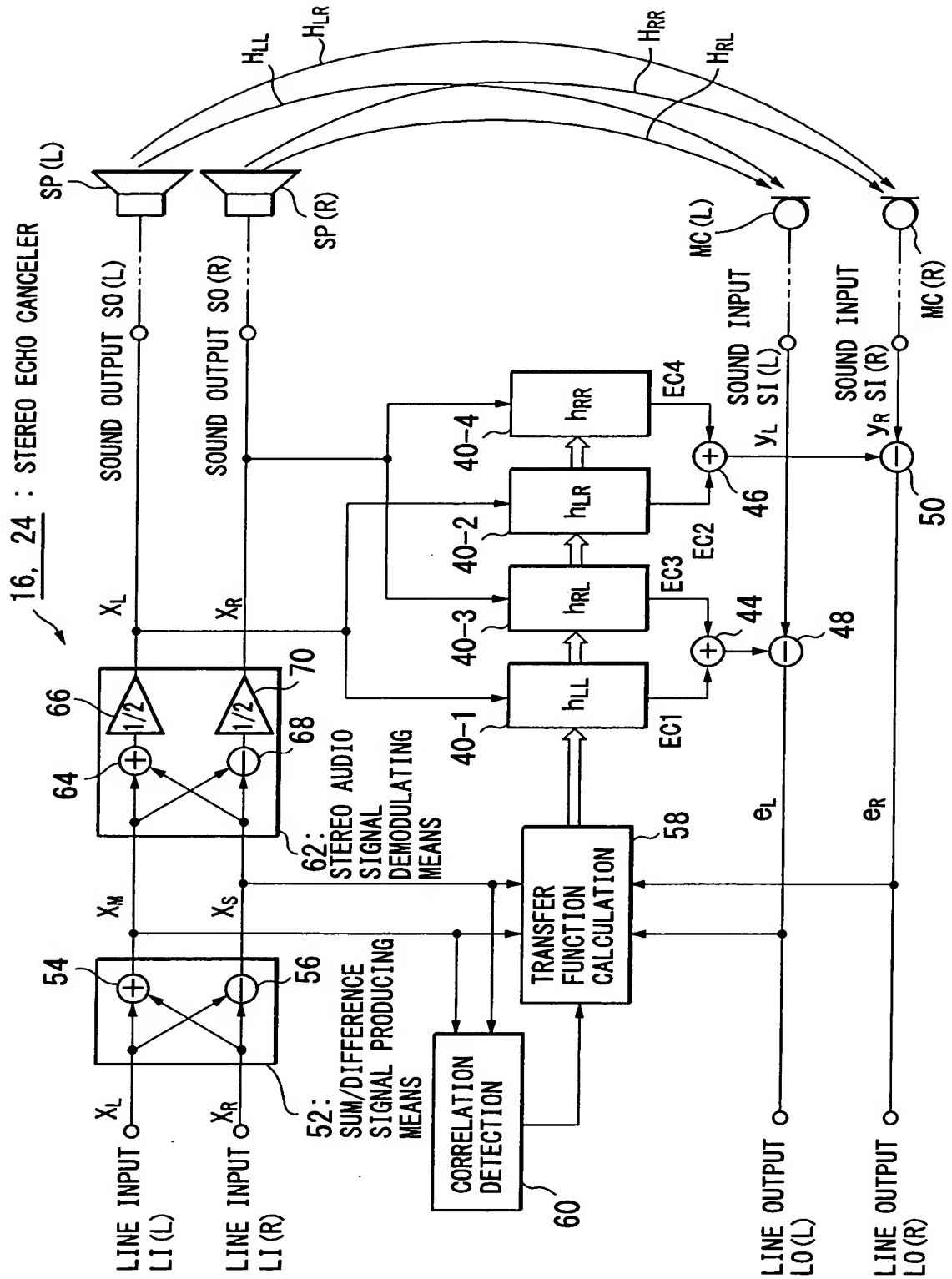

16, 24 : STEREO ECHO CANCELER
SP(L)
SP(R)
MC(L)
MC(R)
H_{LL}
H_{LR}
H_{RR}
H_{RL}
SOUND OUTPUT SO(L)
SOUND OUTPUT SO(R)
SOUND INPUT SI(L) y_L
SOUND INPUT SI(R) y_R
LINE INPUT LI(L) X_L
LINE INPUT LI(R) X_R
LINE OUTPUT LO(L)
LINE OUTPUT LO(R)
X_M
X_S
54
56
52: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
66
64
68
70
62: STEREO AUDIO SIGNAL DEMODULATING MEANS
1/2
40-1 h_{LL} EC1
40-3 h_{RL} EC3
40-2 h_{LR} EC2
40-4 h_{RR} EC4
44
46
48
50
58
TRANSFER FUNCTION CALCULATION
60
CORRELATION DETECTION
e_L
e_R

FIG. 10

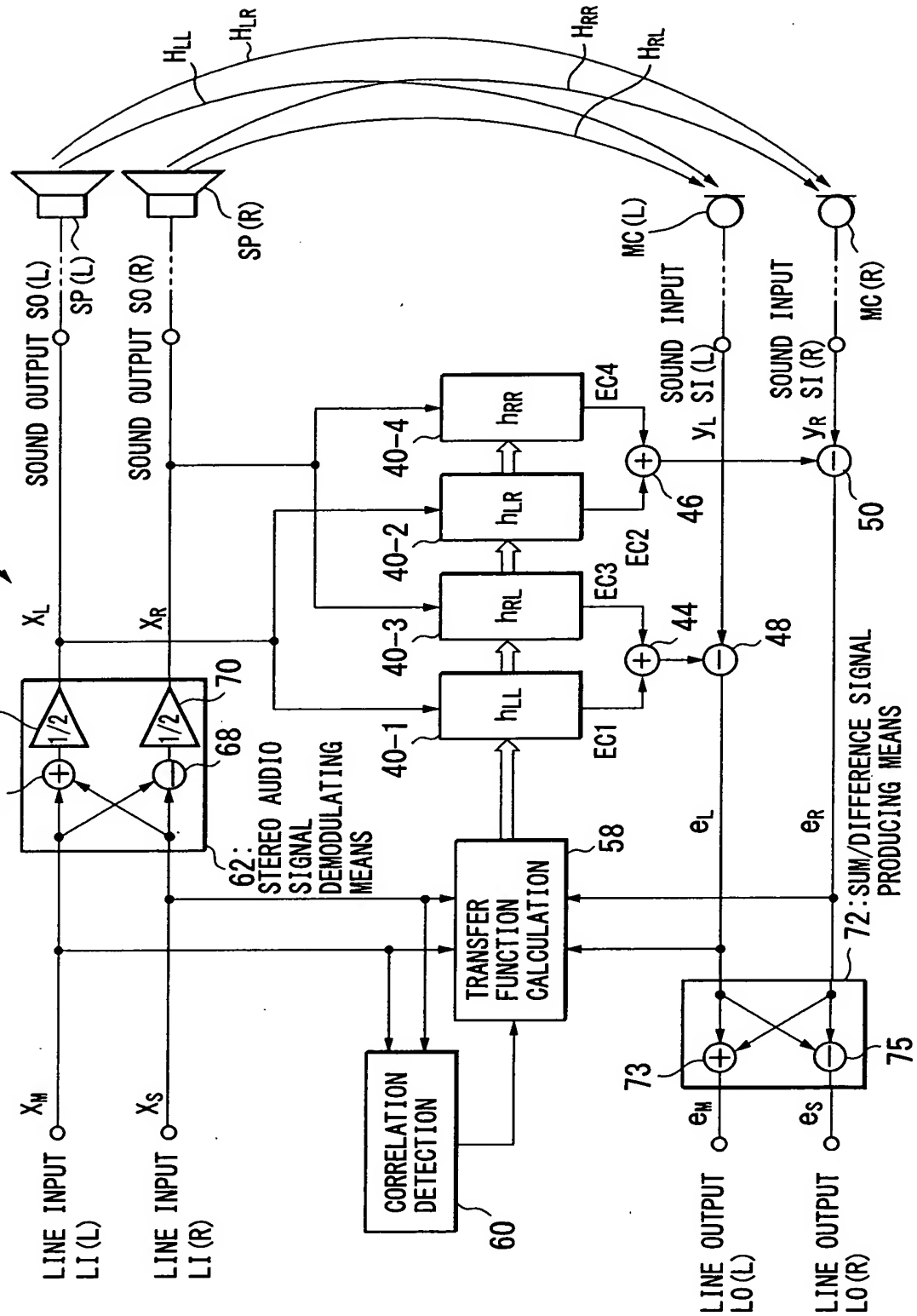

16, 24 : STEREO ECHO CANCELER
SOUND OUTPUT SO(L)
SOUND OUTPUT SO(R)
SP(L)
SP(R)
MC(L)
MC(R)
SOUND INPUT SI(L) y_L
SOUND INPUT SI(R) y_R
H_{LL}
H_{LR}
H_{RR}
H_{RL}
X_L
X_R
X_M
X_S
LINE INPUT LI(L)
LINE INPUT LI(R)
LINE OUTPUT LO(L)
LINE OUTPUT LO(R)
e_M
e_S
e_L
e_R
1/2
64
66
68
70
62: STEREO AUDIO SIGNAL DEMODULATING MEANS
40-1 h_{LL} EC1
40-3 h_{RL} EC3
40-2 h_{LR} EC2
40-4 h_{RR} EC4
44
46
48
50
58
TRANSFER FUNCTION CALCULATION
60
CORRELATION DETECTION
72: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
73
75

FIG. 11

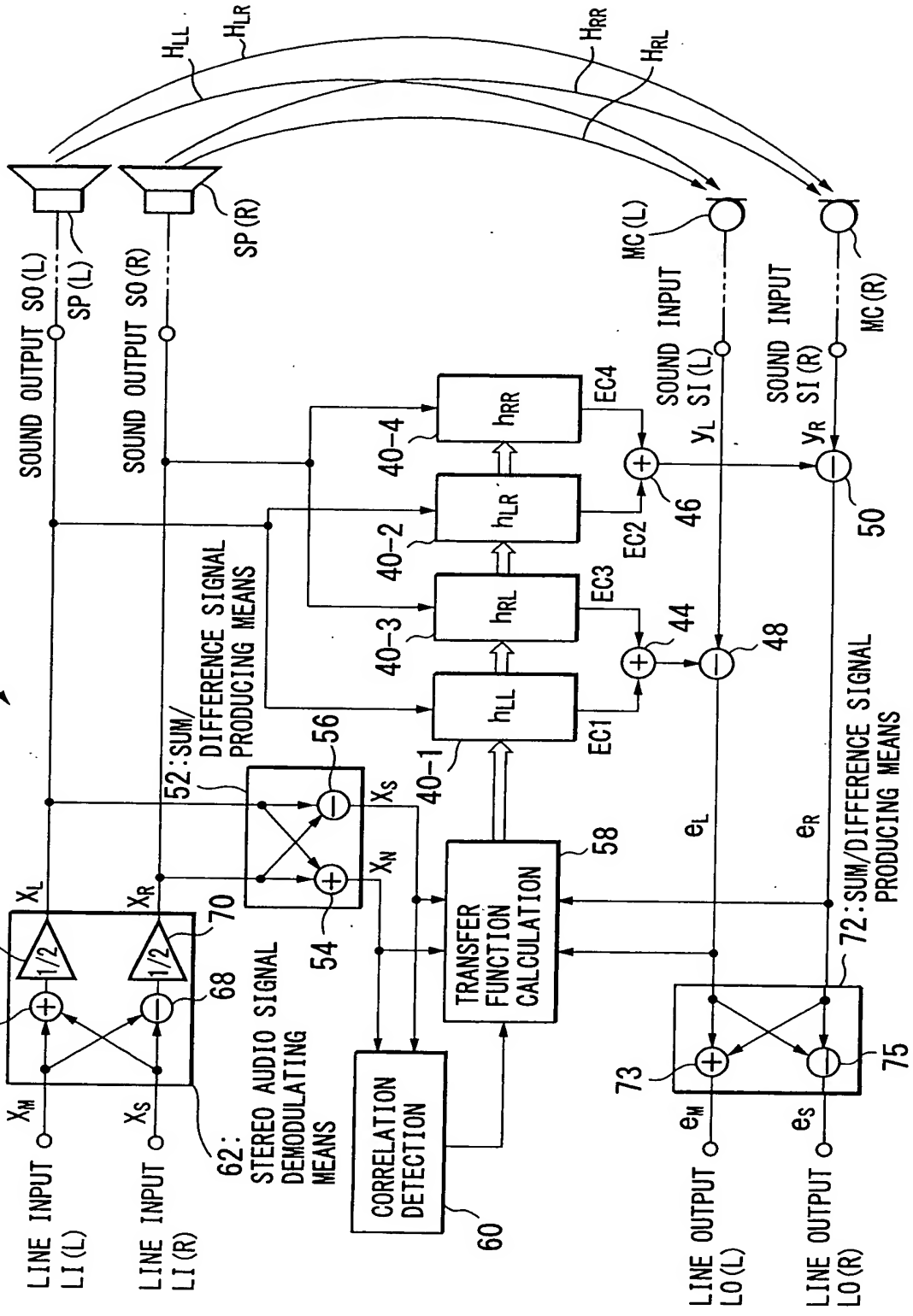

16, 24 : STEREO ECHO CANCELER
SOUND OUTPUT SO(L)
SP(L)
SOUND OUTPUT SO(R)
SP(R)
H_{LL}
H_{LR}
H_{RR}
H_{RL}
MC(L)
MC(R)
SOUND INPUT SI(L) y_L
SOUND INPUT SI(R) y_R
h_{LL}
h_{LR}
h_{RL}
h_{RR}
40-1
40-2
40-3
40-4
EC1
EC2
EC3
EC4
44
46
48
50
52:SUM/DIFFERENCE SIGNAL PRODUCING MEANS
54
56
X_S
X_N
X_L
X_R
66
64
68
70
1/2
1/2
62: STEREO AUDIO SIGNAL DEMODULATING MEANS
LINE INPUT LI(L)
LINE INPUT LI(R)
X_M
X_S
CORRELATION DETECTION
60
TRANSFER FUNCTION CALCULATION
58
e_L
e_R
72:SUM/DIFFERENCE SIGNAL PRODUCING MEANS
73
75
e_M
e_S
LINE OUTPUT LO(L)
LINE OUTPUT LO(R)

FIG. 12

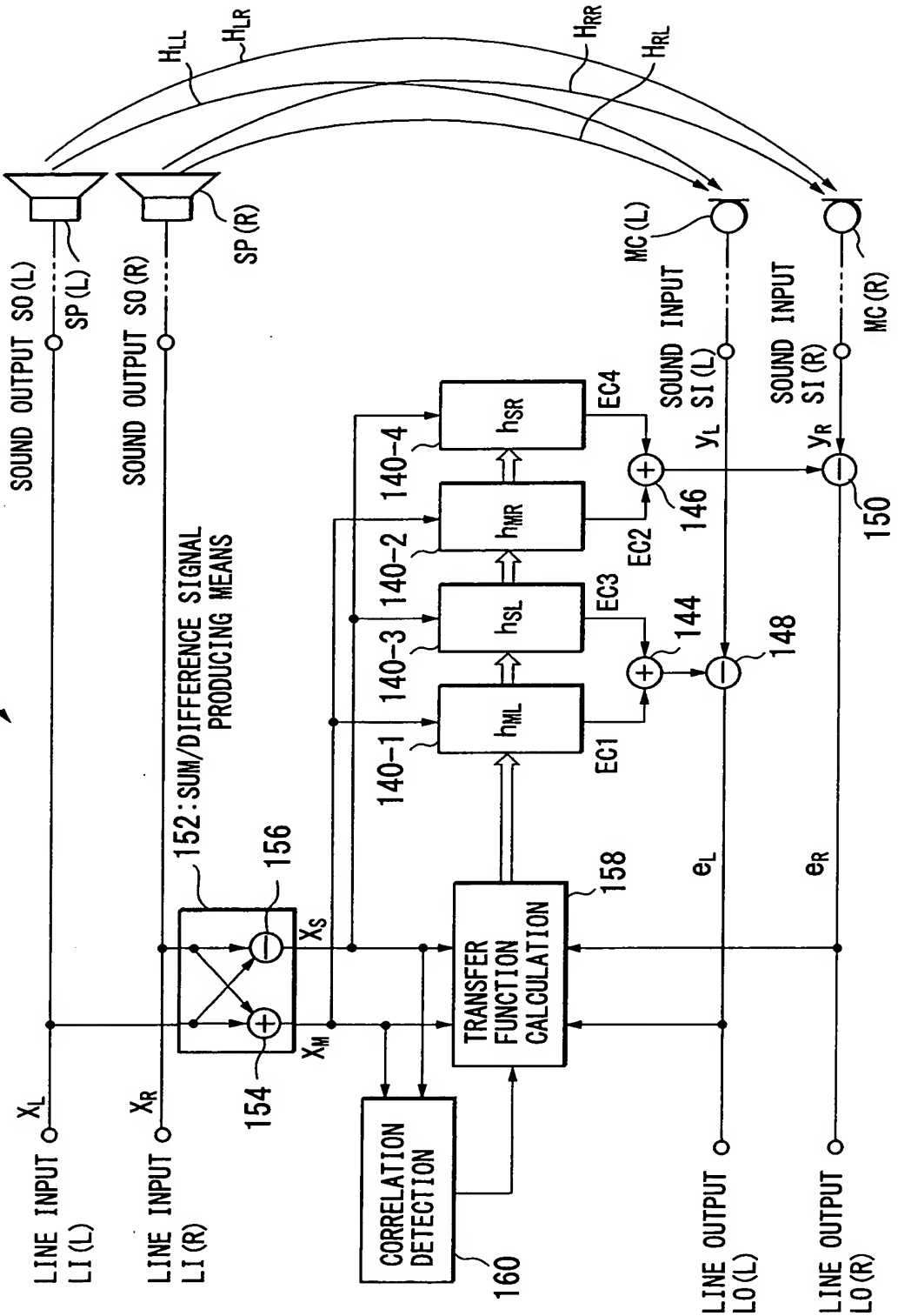

16, 24 : STEREO ECHO CANCELER
SOUND OUTPUT SO(L)
SOUND OUTPUT SO(R)
SP(L)
SP(R)
H_{LL}
H_{LR}
H_{RR}
H_{RL}
MC(L)
MC(R)
SOUND INPUT SI(L)
SOUND INPUT SI(R)
y_L
y_R
146
150
144
148
EC1
EC2
EC3
EC4
h_{ML}
h_{SL}
h_{MR}
h_{SR}
140-1
140-2
140-3
140-4
152 : SUM/DIFFERENCE SIGNAL PRODUCING MEANS
156
154
X_S
X_M
X_L
X_R
LINE INPUT LI(L)
LINE INPUT LI(R)
TRANSFER FUNCTION CALCULATION
158
CORRELATION DETECTION
160
e_L
e_R
LINE OUTPUT LO(L)
LINE OUTPUT LO(R)

FIG. 13

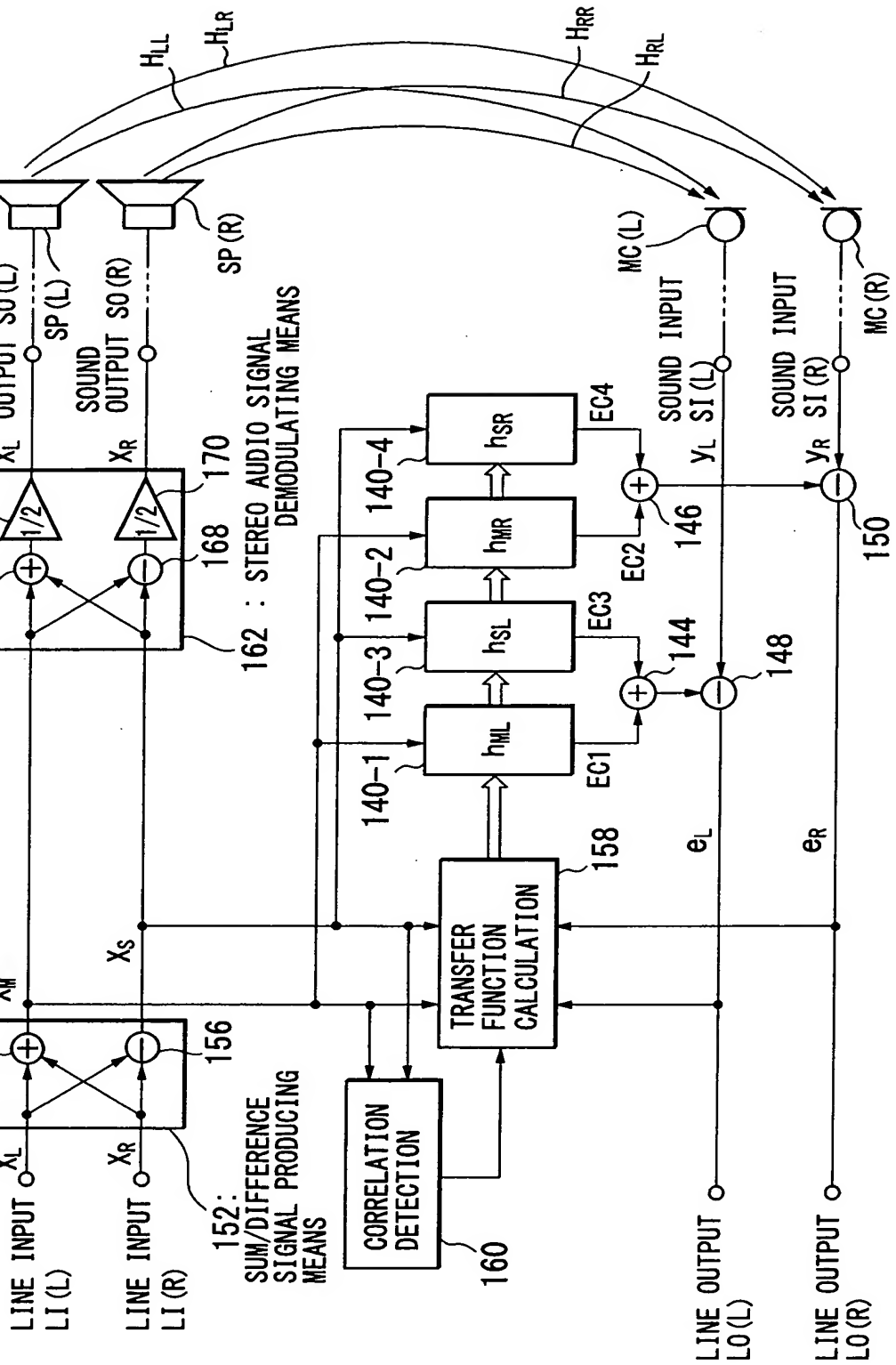

16, 24 : STEREO ECHO CANCELER
SOUND OUTPUT SO(L)
SOUND OUTPUT SO(R)
SP(L)
SP(R)
MC(L)
MC(R)
SOUND INPUT SI(L)
SOUND INPUT SI(R)
LINE INPUT LI(L)
LINE INPUT LI(R)
LINE OUTPUT LO(L)
LINE OUTPUT LO(R)
162 : STEREO AUDIO SIGNAL DEMODULATING MEANS
152: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
TRANSFER FUNCTION CALCULATION
CORRELATION DETECTION
1/2
EC1
EC2
EC3
EC4

FIG. 14

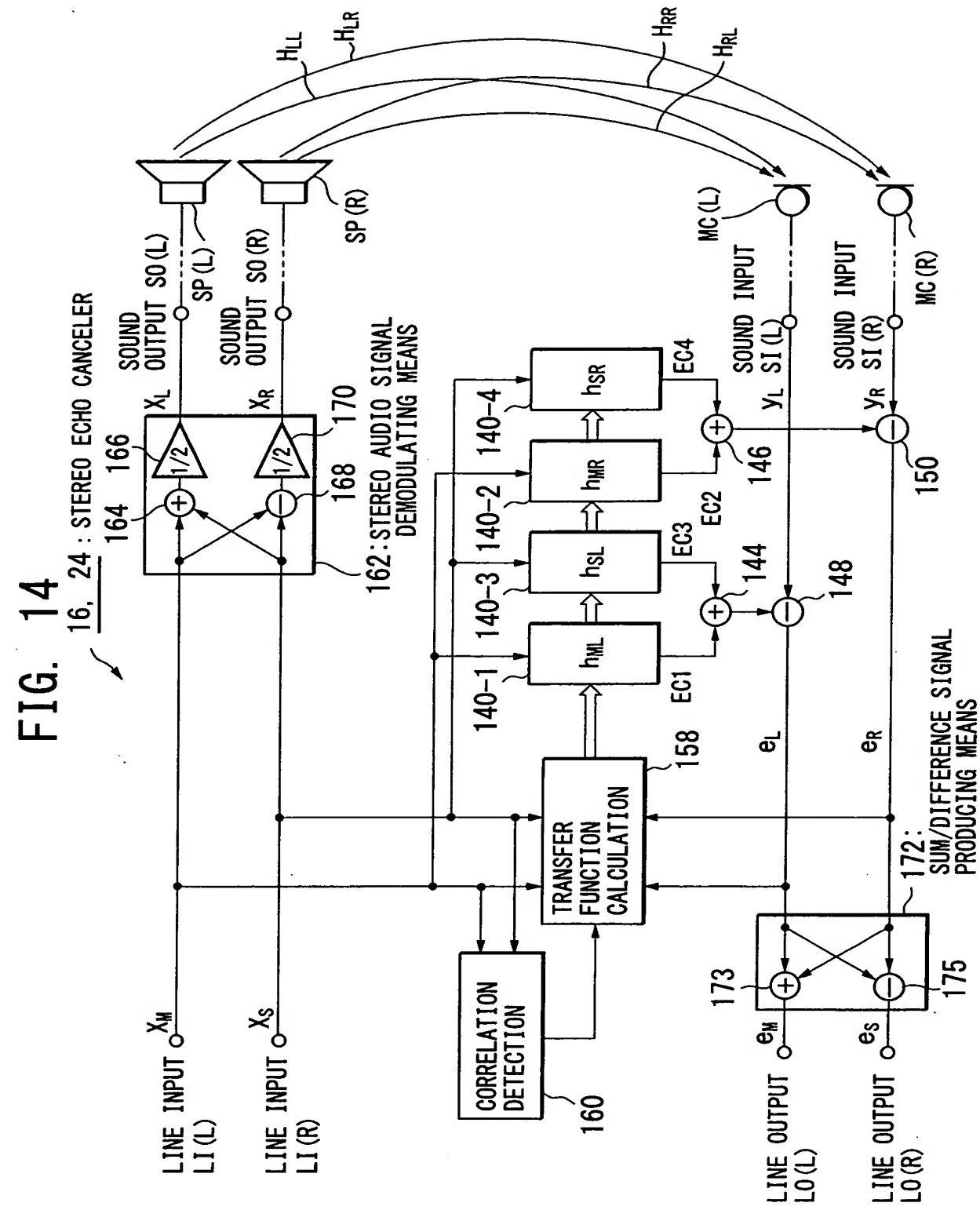

16, 24 : STEREO ECHO CANCELER
SOUND OUTPUT SO(L)
SOUND OUTPUT SO(R)
SP(L)
SP(R)
H_{LL}
H_{LR}
H_{RR}
H_{RL}
MC(L)
MC(R)
SOUND INPUT SI(L)
SOUND INPUT SI(R)
x_L
x_R
y_L
y_R
1/2
164
166
168
170
162: STEREO AUDIO SIGNAL DEMODULATING MEANS
140-1
140-2
140-3
140-4
h_{ML}
h_{SL}
h_{MR}
h_{SR}
EC1
EC2
EC3
EC4
144
146
148
150
158
TRANSFER FUNCTION CALCULATION
e_L
e_R
172: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
173
175
e_M
e_S
LINE OUTPUT LO(L)
LINE OUTPUT LO(R)
x_M
x_S
LINE INPUT LI(L)
LINE INPUT LI(R)
CORRELATION DETECTION
160

FIG. 15

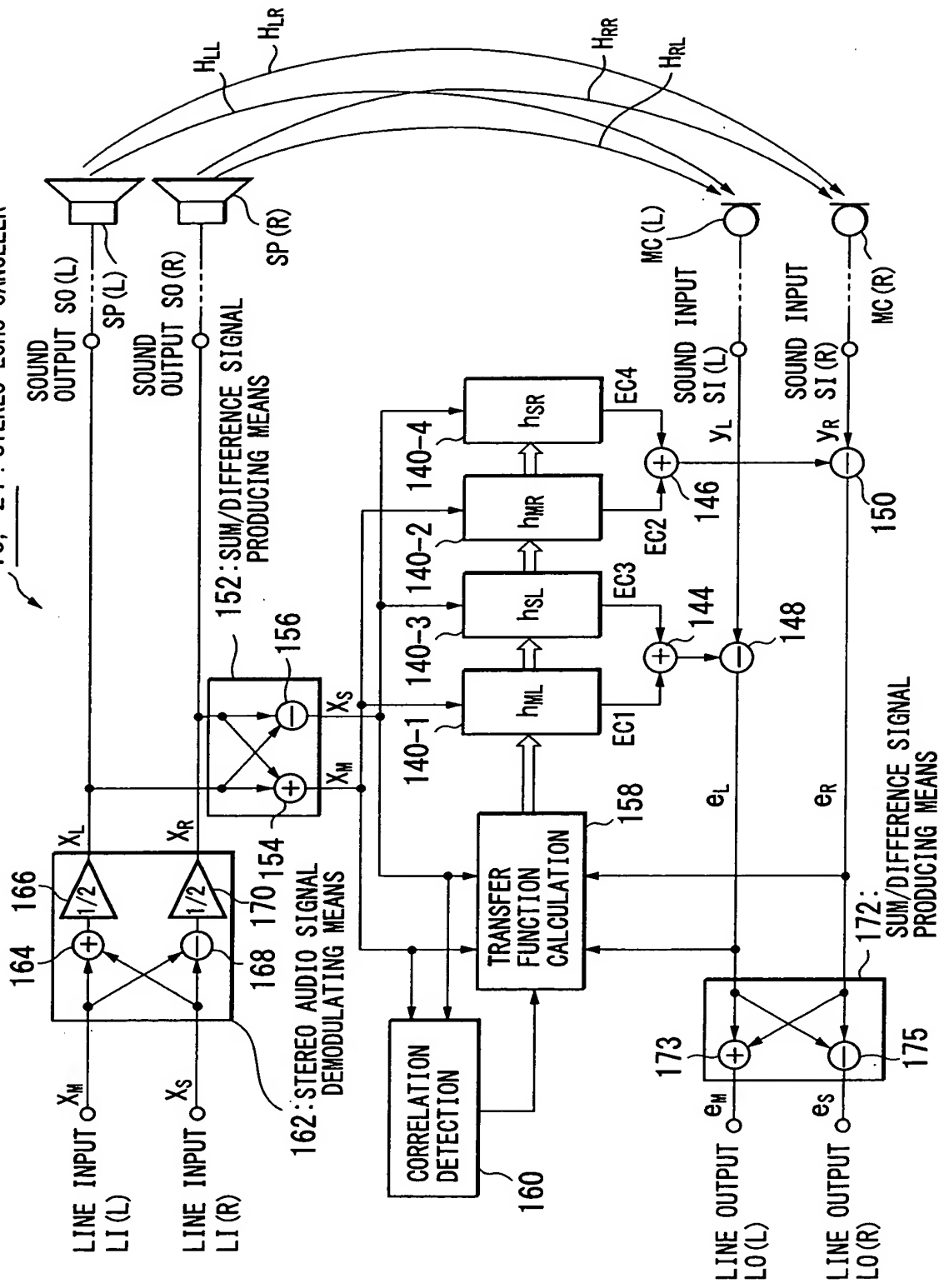

16, 24 : STEREO ECHO CANCELER
SOUND OUTPUT SO(L)
SP(L)
SOUND OUTPUT SO(R)
SP(R)
H_{LL}
H_{LR}
H_{RR}
H_{RL}
MC(L)
MC(R)
SOUND INPUT SI(L)
SOUND INPUT SI(R)
152: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
156
154
162: STEREO AUDIO SIGNAL DEMODULATING MEANS
166
164
168
170
1/2
1/2
X_L
X_R
X_M
X_S
LINE INPUT LI(L)
LINE INPUT LI(R)
140-1
140-2
140-3
140-4
h_{ML}
h_{MR}
h_{SL}
h_{SR}
EC1
EC2
EC3
EC4
144
146
148
150
158
TRANSFER FUNCTION CALCULATION
CORRELATION DETECTION
160
y_L
y_R
e_L
e_R
173
175
172: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
e_M
e_S
LINE OUTPUT LO(L)
LINE OUTPUT LO(R)

FIG. 16

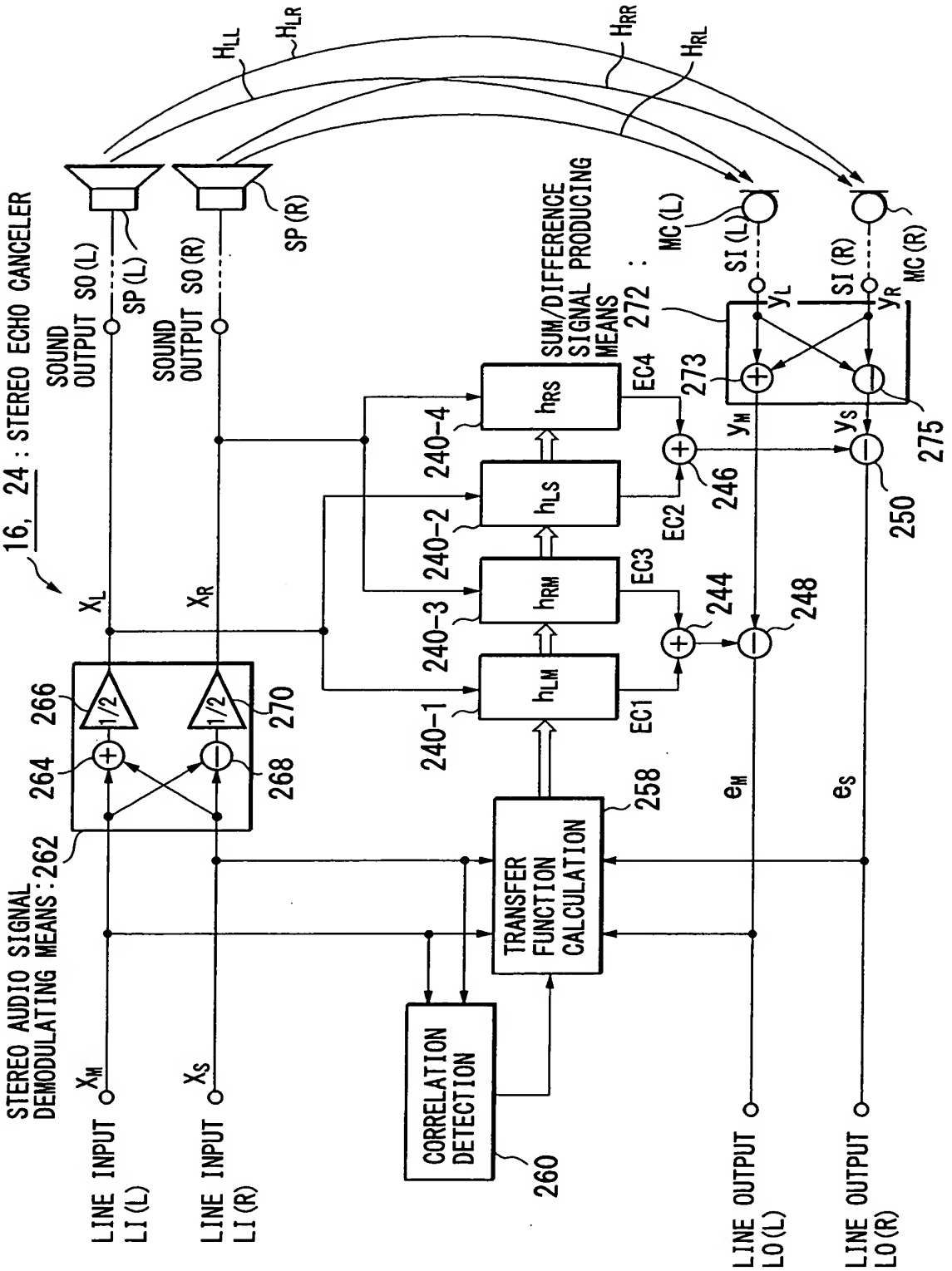

16, 24 : STEREO ECHO CANCELER
STEREO AUDIO SIGNAL DEMODULATING MEANS : 262
SOUND OUTPUT SO(L)
SOUND OUTPUT SO(R)
SP(L)
SP(R)
MC(L)
MC(R)
SI(L)
SI(R)
LINE INPUT LI(L)
LINE INPUT LI(R)
LINE OUTPUT LO(L)
LINE OUTPUT LO(R)
SUM/DIFFERENCE SIGNAL PRODUCING MEANS 272
TRANSFER FUNCTION CALCULATION 258
CORRELATION DETECTION 260
240-1
240-2
240-3
240-4
EC1
EC2
EC3
EC4
246
248
250
264
266
268
270
273
275

FIG. 17

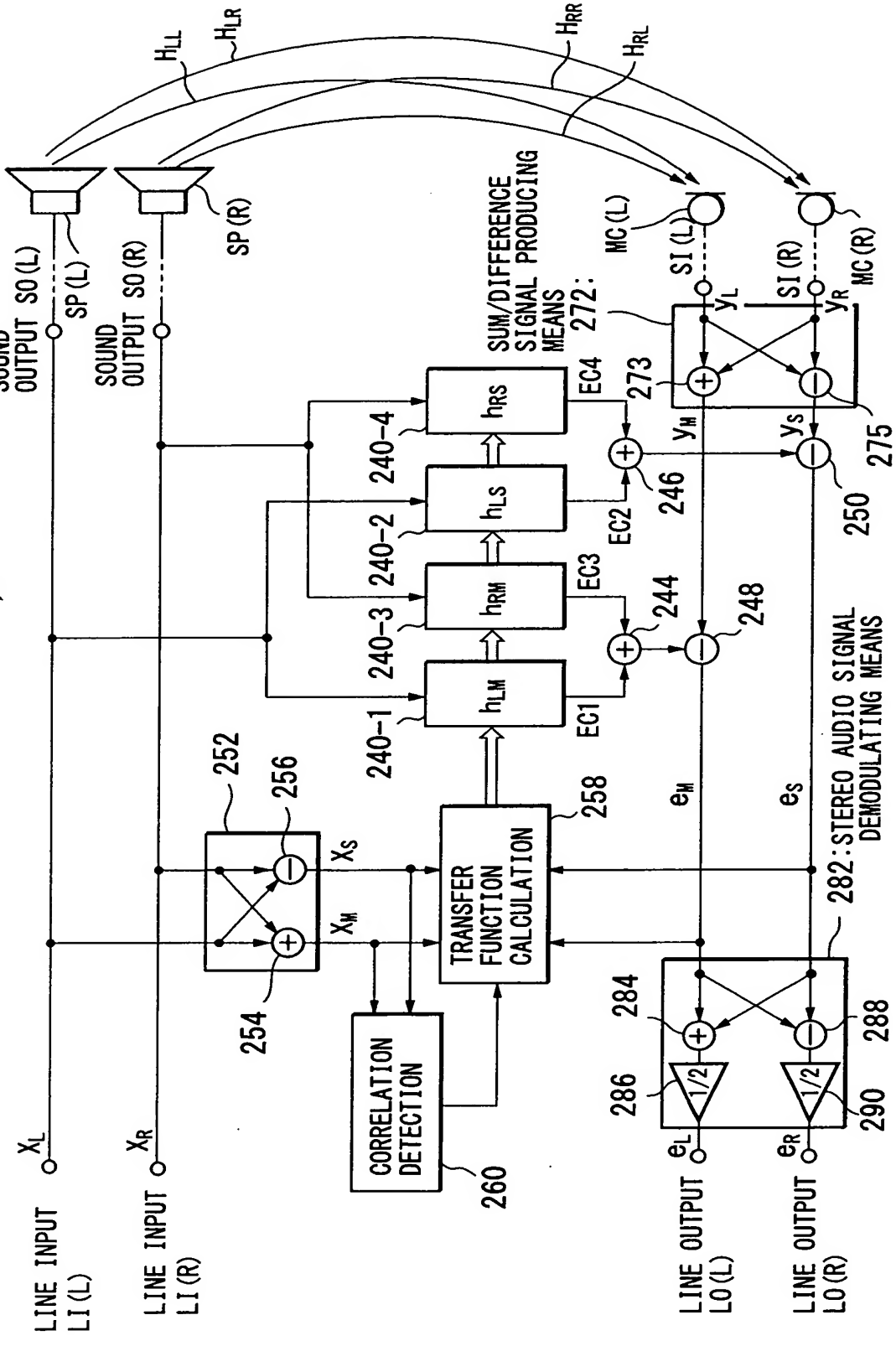

16, 24 : STEREO ECHO CANCELER
SOUND OUTPUT SO(L)
SOUND OUTPUT SO(R)
SP(L)
SP(R)
H_{LL}
H_{LR}
H_{RR}
H_{RL}
MC(L)
MC(R)
SI(L)
SI(R)
y_L
y_R
y_M
y_S
SUM/DIFFERENCE SIGNAL PRODUCING MEANS 272
273
275
240-1
240-2
240-3
240-4
h_{LM}
h_{LS}
h_{RM}
h_{RS}
EC1
EC2
EC3
EC4
244
246
248
250
252
254
256
X_S
X_M
TRANSFER FUNCTION CALCULATION
258
CORRELATION DETECTION
260
e_M
e_S
282: STEREO AUDIO SIGNAL DEMODULATING MEANS
284
286
288
290
1/2
1/2
e_L
e_R
X_L
X_R
LINE INPUT LI(L)
LINE INPUT LI(R)
LINE OUTPUT LO(L)
LINE OUTPUT LO(R)

FIG. 18

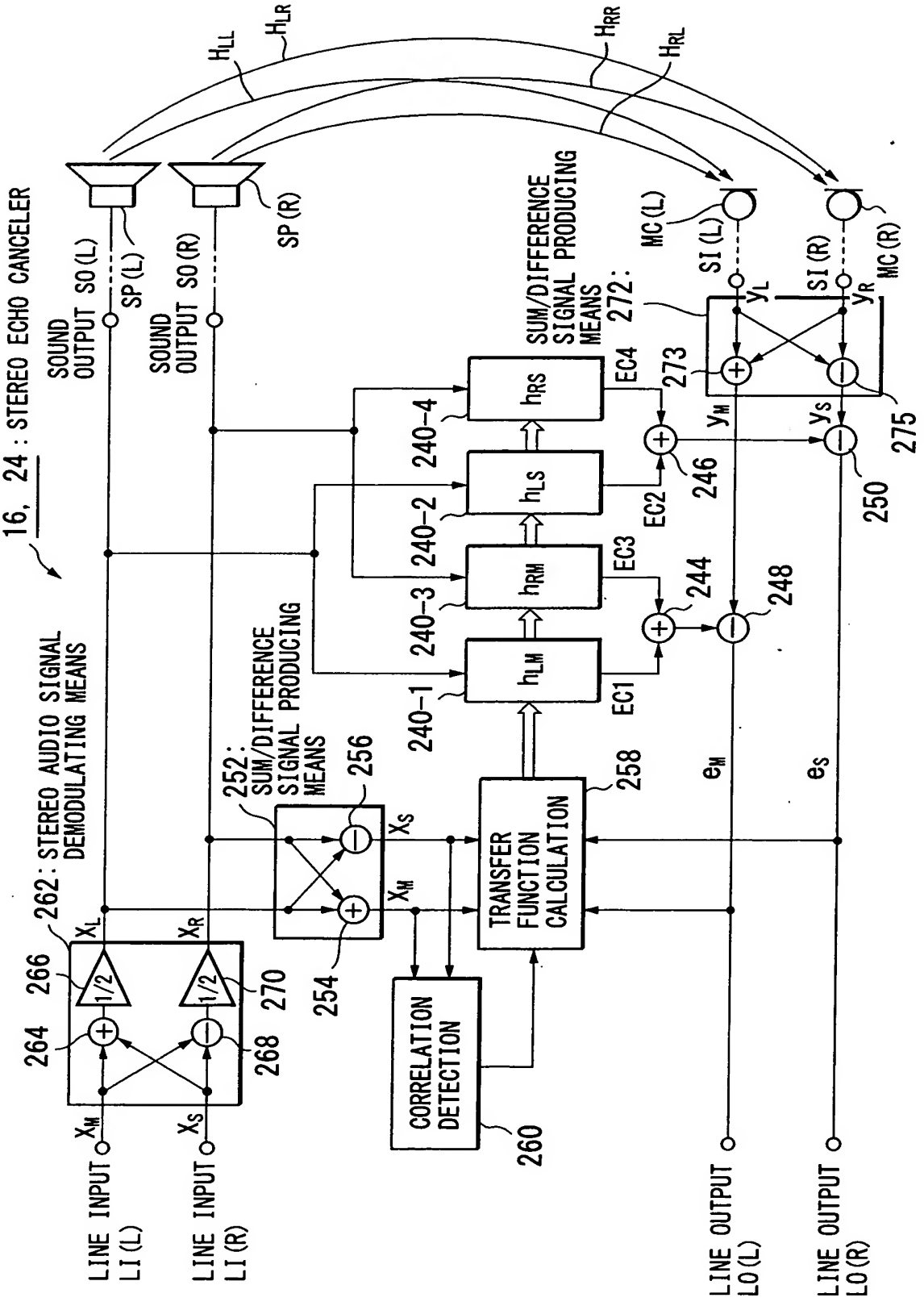

16, 24 : STEREO ECHO CANCELER
SOUND OUTPUT SO(L)
SOUND OUTPUT SO(R)
SP(L)
SP(R)
H_{LL}
H_{LR}
H_{RR}
H_{RL}
MC(L)
MC(R)
SI(L)
SI(R)
262: STEREO AUDIO SIGNAL DEMODULATING MEANS
252: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
272: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
240-1
240-2
240-3
240-4
h_{LM}
h_{LS}
h_{RM}
h_{RS}
EC1
EC2
EC3
EC4
TRANSFER FUNCTION CALCULATION
CORRELATION DETECTION
LINE INPUT LI(L)
LINE INPUT LI(R)
LINE OUTPUT LO(L)
LINE OUTPUT LO(R)
1/2
X_L
X_R
X_M
X_S
y_L
y_R
y_M
y_S
e_M
e_S
246
248
250
254
256
258
260
264
266
268
270
273
275

FIG. 19

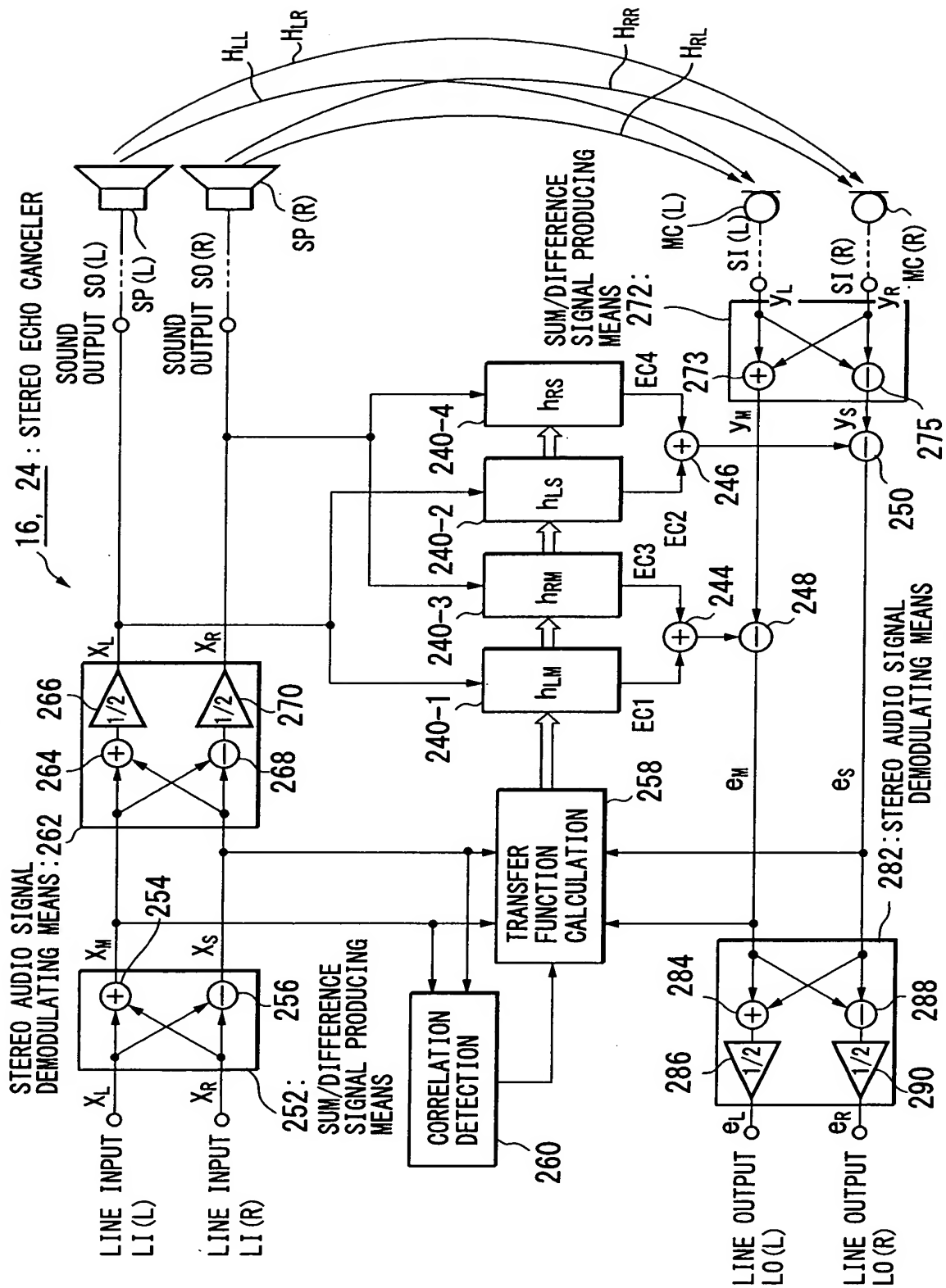

16, 24 : STEREO ECHO CANCELER
SOUND OUTPUT SO(L)
SOUND OUTPUT SO(R)
SP(L)
SP(R)
H_{LL}
H_{LR}
H_{RR}
H_{RL}
MC(L)
MC(R)
SI(L)
SI(R)
y_L
y_R
y_M
y_S
SUM/DIFFERENCE SIGNAL PRODUCING MEANS 272:
273
275
246
250
EC4
EC2
EC3
EC1
h_{RS}
h_{LS}
h_{RM}
h_{LM}
240-4
240-2
240-3
240-1
244
248
258
TRANSFER FUNCTION CALCULATION
CORRELATION DETECTION
260
e_M
e_S
282: STEREO AUDIO SIGNAL DEMODULATING MEANS
284
286
288
290
e_L
e_R
LINE OUTPUT LO(L)
LINE OUTPUT LO(R)
X_L
X_R
X_M
X_S
LINE INPUT LI(L)
LINE INPUT LI(R)
252: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
254
256
STEREO AUDIO SIGNAL DEMODULATING MEANS: 262
264
266
268
270
1/2

FIG. 20

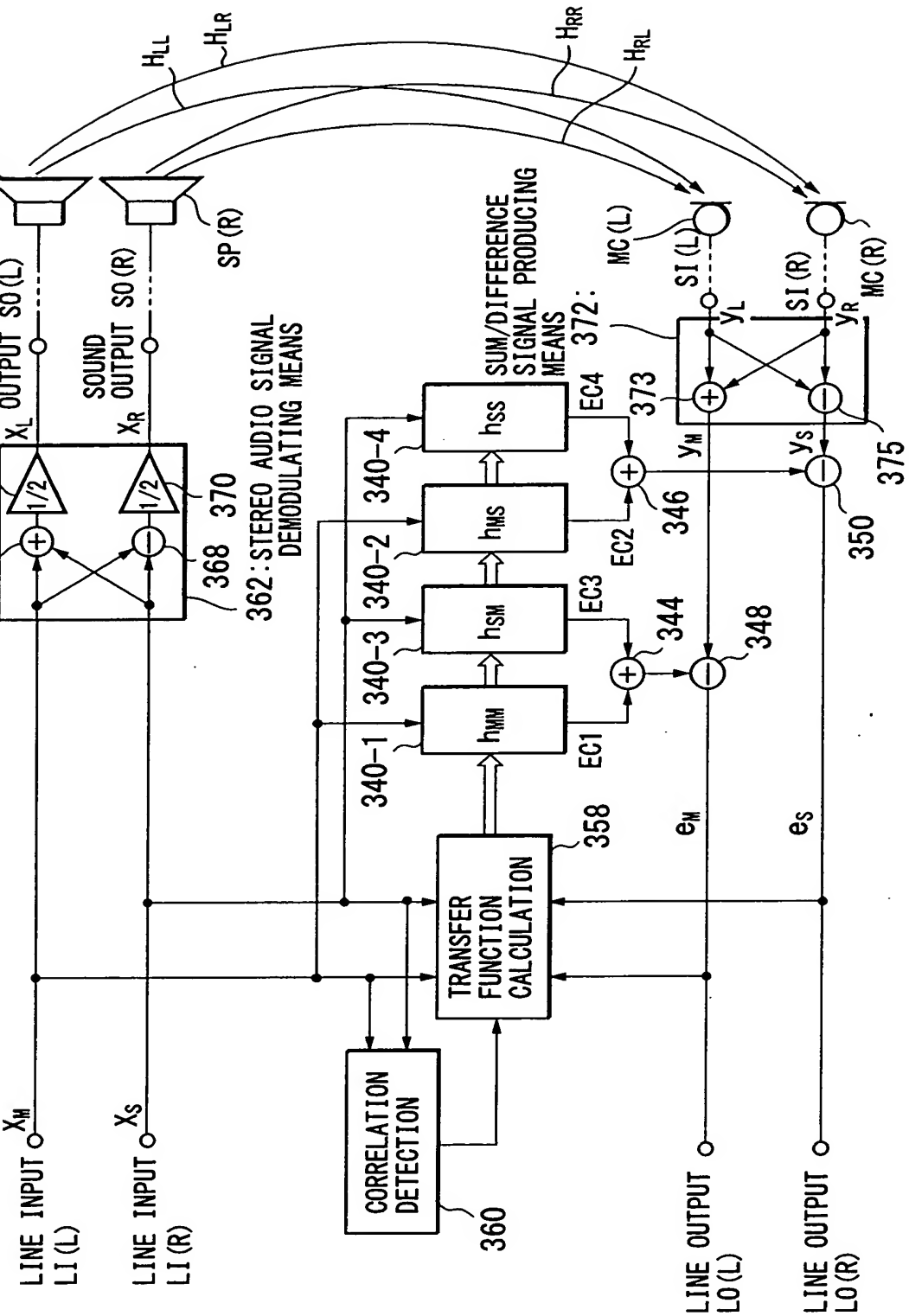

16, 24 : STEREO ECHO CANCELER
SP (L)
SP (R)
H_{LL}
H_{LR}
H_{RR}
H_{RL}
SOUND OUTPUT SO (L)
SOUND OUTPUT SO (R)
X_L
X_R
366
364
368
370
1/2
362 : STEREO AUDIO SIGNAL DEMODULATING MEANS
MC (L)
MC (R)
SI (L)
SI (R)
y_L
y_R
SUM/DIFFERENCE SIGNAL PRODUCING MEANS
372
373
375
y_M
y_S
346
350
340-1
340-2
340-3
340-4
h_{MM}
h_{SM}
h_{MS}
h_{SS}
EC1
EC2
EC3
EC4
344
348
358
e_M
e_S
TRANSFER FUNCTION CALCULATION
CORRELATION DETECTION
360
X_M
X_S
LINE INPUT LI (L)
LINE INPUT LI (R)
LINE OUTPUT LO (L)
LINE OUTPUT LO (R)

FIG. 21

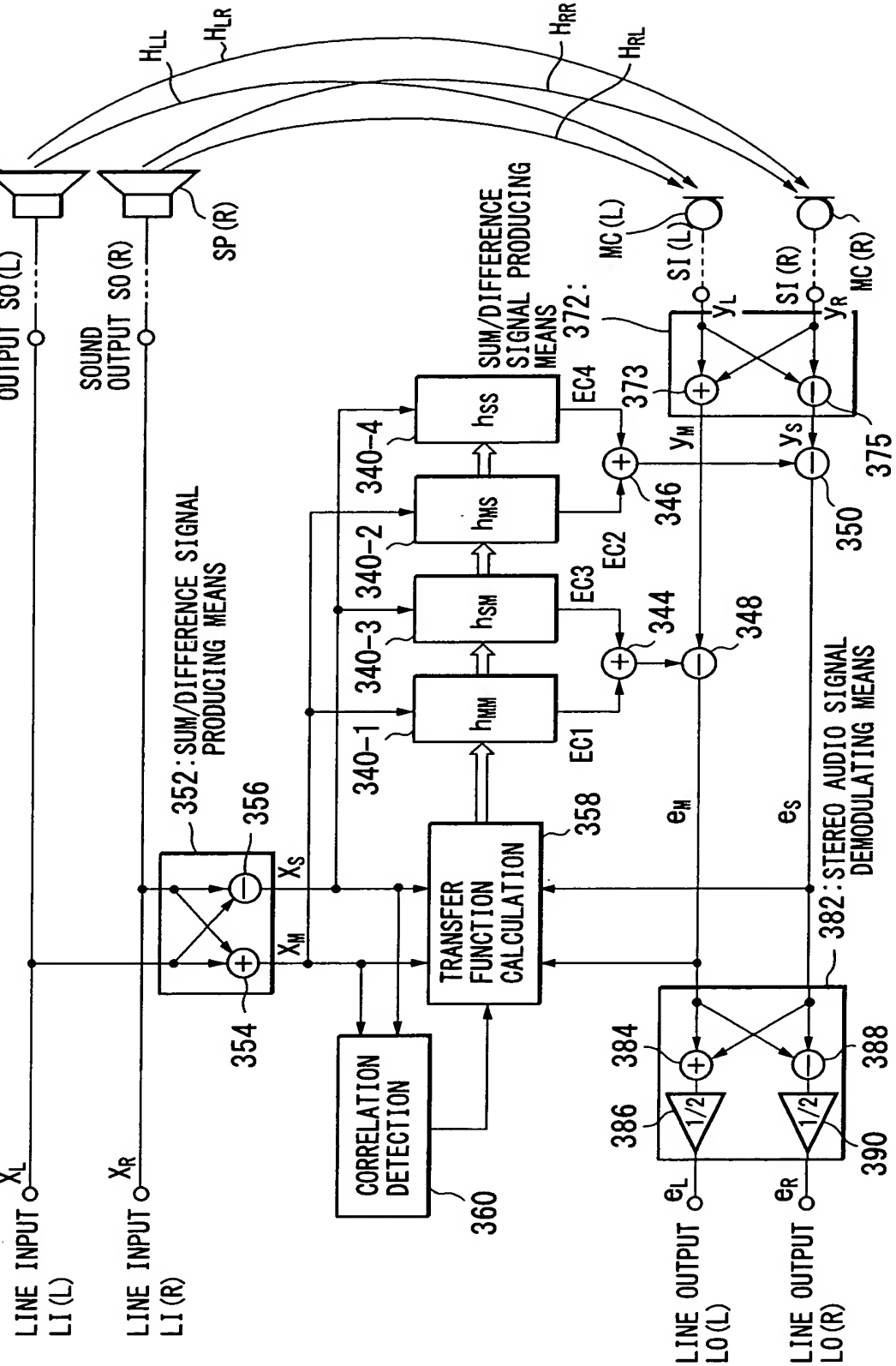

16, 24 : STEREO ECHO CANCELER
SP (L)
SP (R)
H_{LL}
H_{LR}
H_{RR}
H_{RL}
SOUND OUTPUT SO (L)
SOUND OUTPUT SO (R)
MC (L)
MC (R)
SI (L)
SI (R)
y_L
y_R
y_M
y_S
SUM/DIFFERENCE SIGNAL PRODUCING MEANS 372:
373
375
346
350
344
348
EC4
EC2
EC3
EC1
h_{SS}
h_{MS}
h_{SM}
h_{MM}
340-4
340-2
340-3
340-1
352: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
356
354
X_S
X_M
X_L
X_R
LINE INPUT LI (L)
LINE INPUT LI (R)
TRANSFER FUNCTION CALCULATION
358
CORRELATION DETECTION
360
e_M
e_S
382: STEREO AUDIO SIGNAL DEMODULATING MEANS
384
386
388
390
1/2
1/2
e_L
e_R
LINE OUTPUT LO (L)
LINE OUTPUT LO (R)

FIG. 22

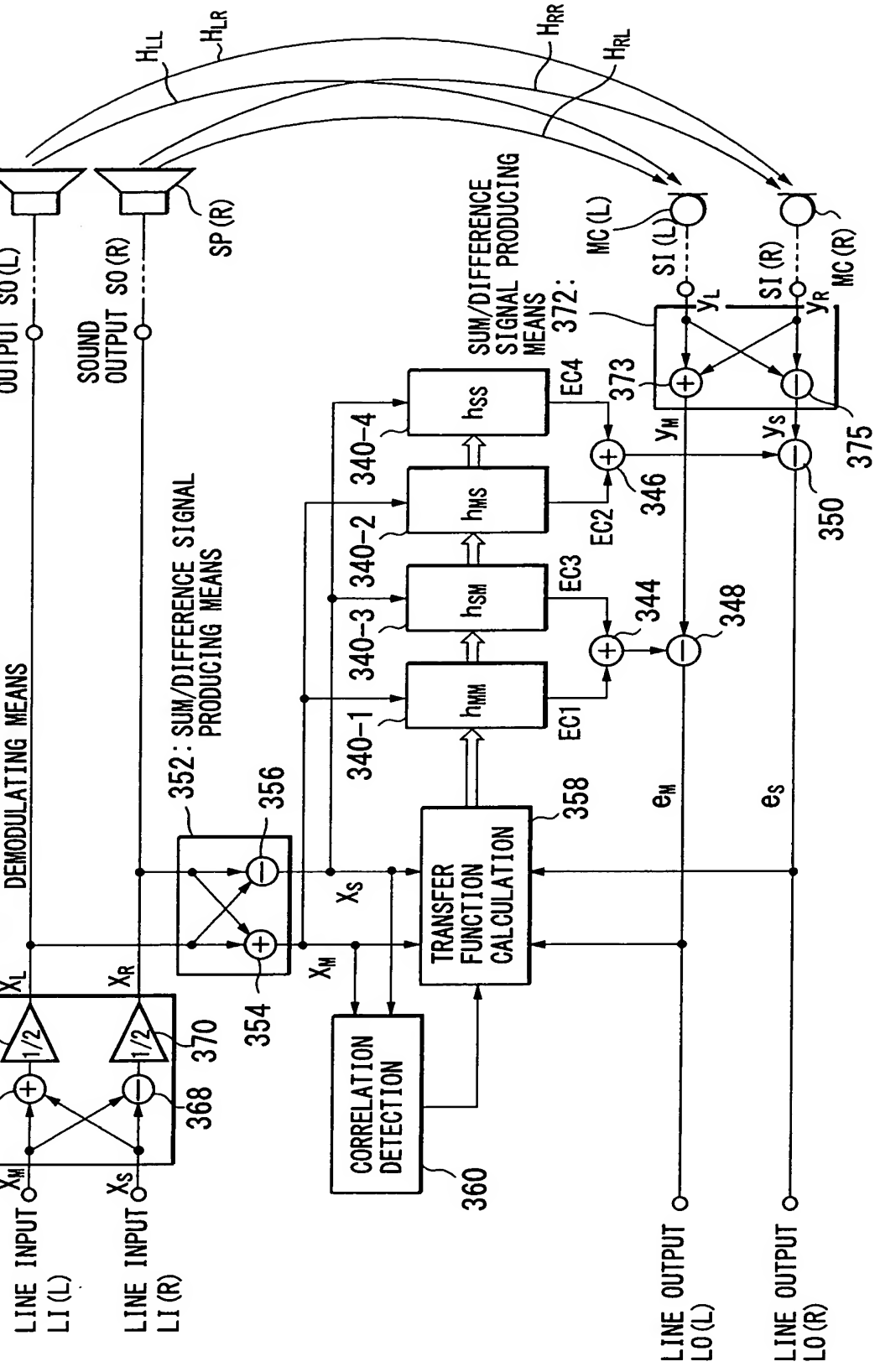

16, 24 : STEREO ECHO CANCELER
SP (L)
SP (R)
H_{LL}
H_{LR}
H_{RR}
H_{RL}
SOUND OUTPUT SO (L)
SOUND OUTPUT SO (R)
MC (L)
MC (R)
SI (L)
SI (R)
362 : STEREO AUDIO SIGNAL DEMODULATING MEANS
352 : SUM/DIFFERENCE SIGNAL PRODUCING MEANS
SUM/DIFFERENCE SIGNAL PRODUCING MEANS 372 :
340-1
340-2
340-3
340-4
h_{MM}
h_{SM}
h_{MS}
h_{SS}
EC1
EC2
EC3
EC4
TRANSFER FUNCTION CALCULATION
CORRELATION DETECTION
358
360
344
346
348
350
373
375
354
356
366
368
370
364
1/2
X_L
X_R
X_M
X_S
y_L
y_R
y_M
y_S
e_M
e_S
LINE INPUT LI (L)
LINE INPUT LI (R)
LINE OUTPUT LO (L)
LINE OUTPUT LO (R)

FIG. 23

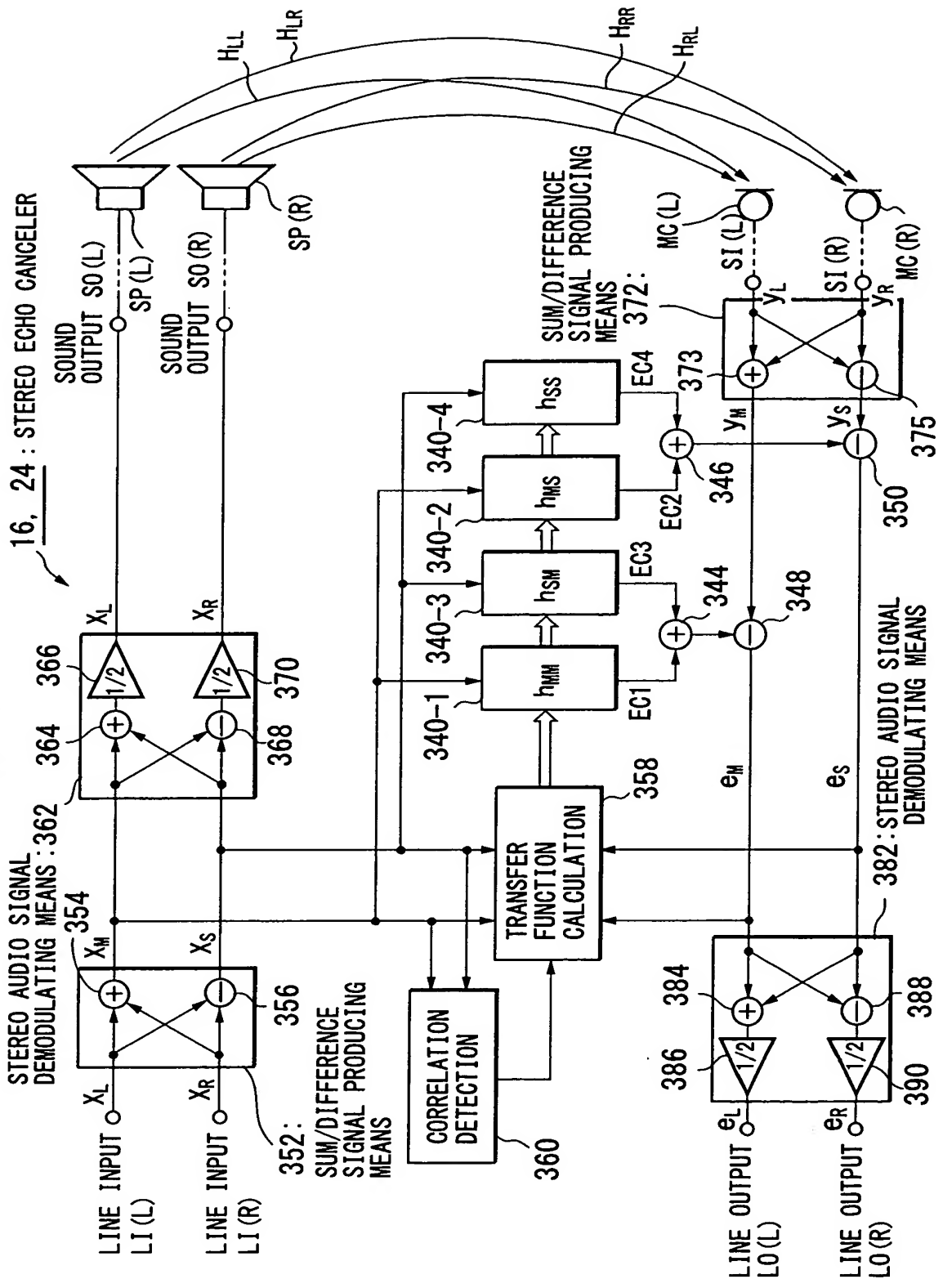

16, 24 : STEREO ECHO CANCELER
SOUND OUTPUT SO(L)
SOUND OUTPUT SO(R)
SP(L)
SP(R)
H_{LL}
H_{LR}
H_{RR}
H_{RL}
MC(L)
MC(R)
SI(L)
SI(R)
y_L
y_R
y_M
y_S
SUM/DIFFERENCE SIGNAL PRODUCING MEANS 372:
373
375
346
350
EC4
EC2
EC3
EC1
344
348
340-1
340-2
340-3
340-4
h_{MM}
h_{SM}
h_{MS}
h_{SS}
TRANSFER FUNCTION CALCULATION
358
CORRELATION DETECTION
360
e_M
e_S
382: STEREO AUDIO SIGNAL DEMODULATING MEANS
384
386
388
390
e_L
e_R
LINE OUTPUT LO(L)
LINE OUTPUT LO(R)
STEREO AUDIO SIGNAL DEMODULATING MEANS: 362
354
356
352: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
X_M
X_S
X_L
X_R
LINE INPUT LI(L)
LINE INPUT LI(R)
366
364
368
370
1/2

FIG. 24

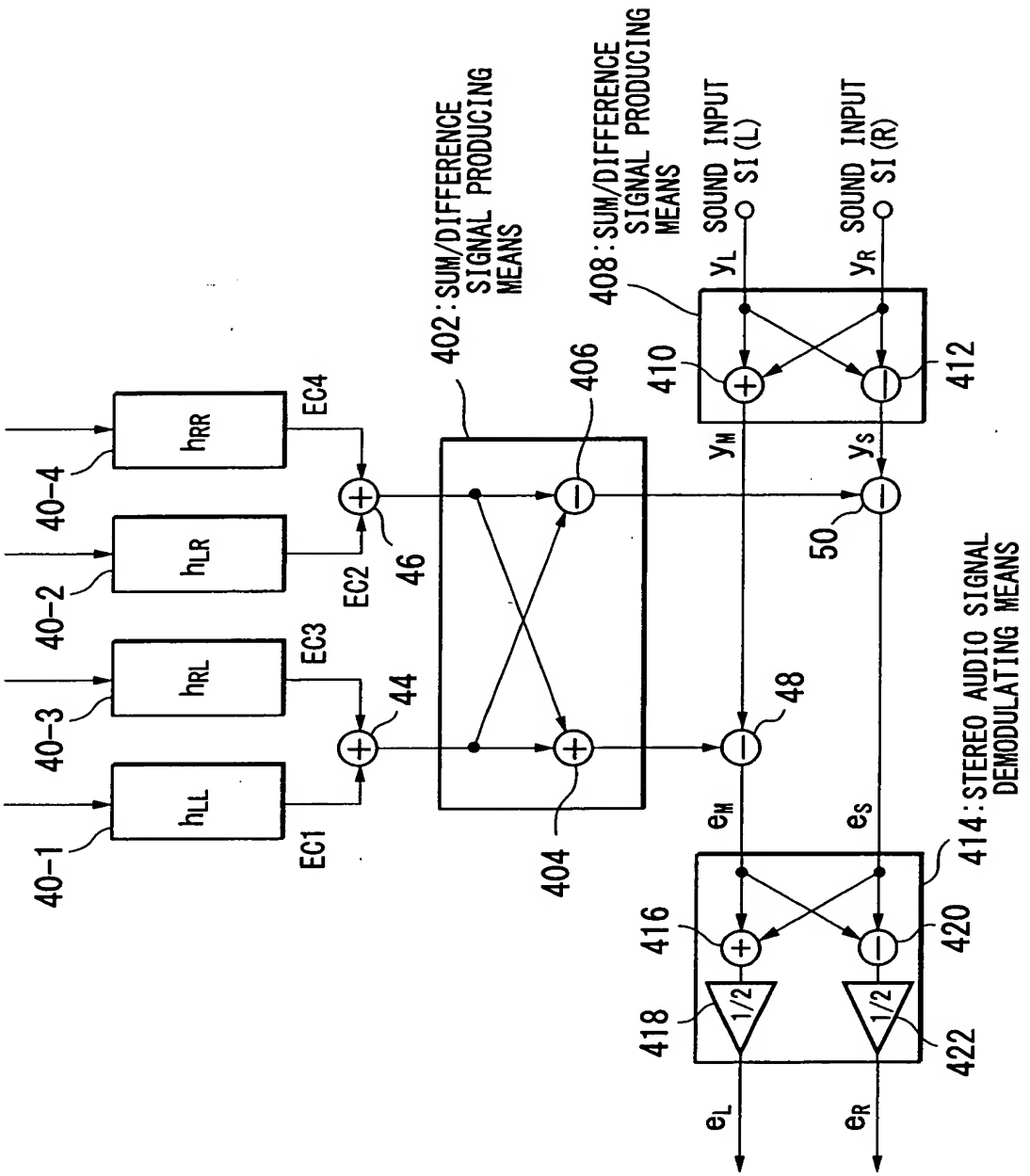

40-1
40-3
40-2
40-4
h_{LL}
h_{RL}
h_{LR}
h_{RR}
EC1
EC3
EC2
EC4
44
46
402: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
404
406
408: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
y_L SOUND INPUT SI(L)
y_R SOUND INPUT SI(R)
410
412
y_M
y_S
50
48
e_M
e_S
414: STEREO AUDIO SIGNAL DEMODULATING MEANS
416
420
418
422
1/2
1/2
e_L
e_R

FIG. 25

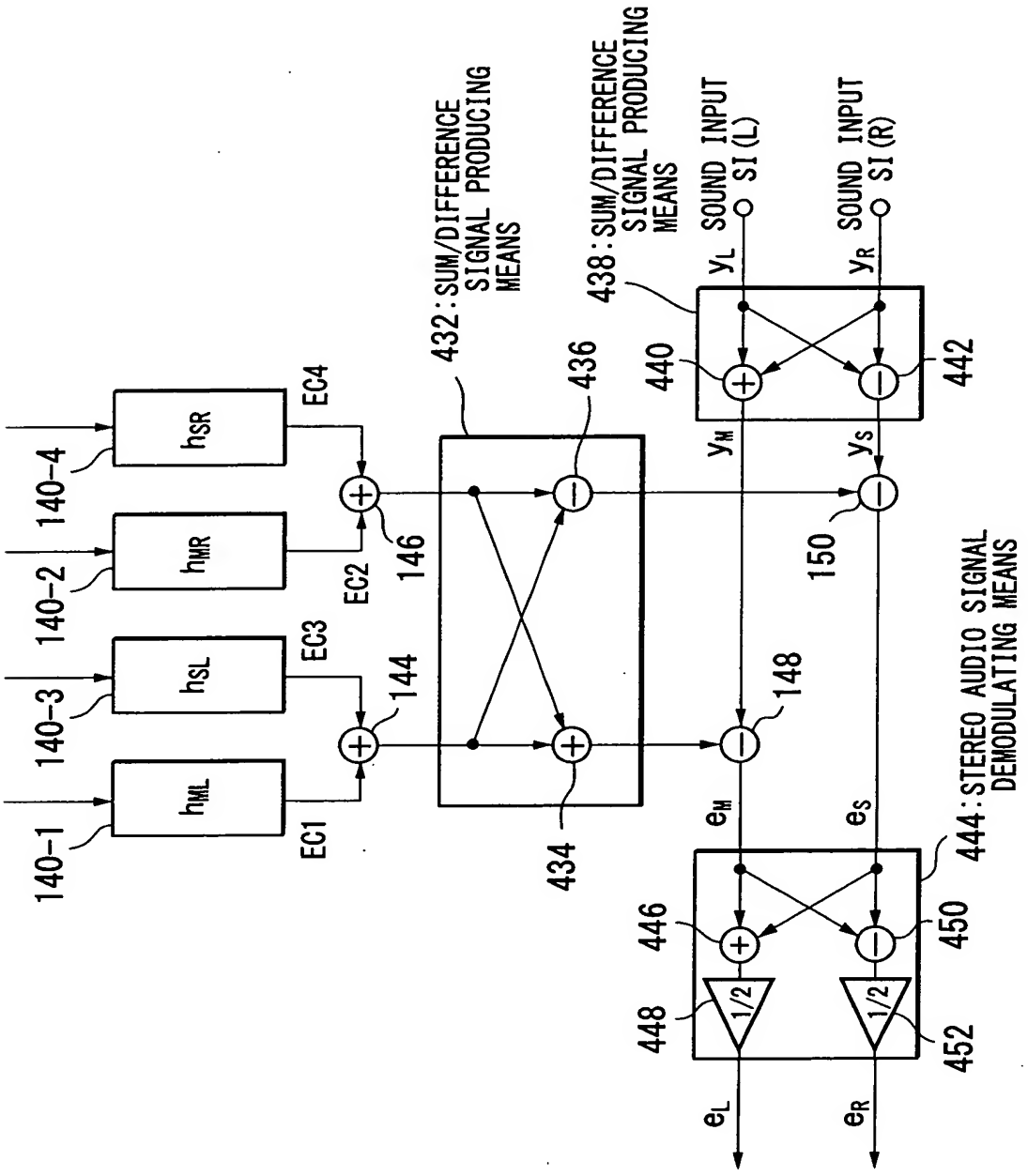

140-1
140-2
140-3
140-4
h_{ML}
h_{MR}
h_{SL}
h_{SR}
EC1
EC2
EC3
EC4
144
146
432: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
434
436
438: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
y_L SOUND INPUT SI(L)
y_R SOUND INPUT SI(R)
440
442
y_M
y_S
148
150
e_M
e_S
444: STEREO AUDIO SIGNAL DEMODULATING MEANS
446
448
450
452
1/2
1/2
e_L
e_R

FIG. 26

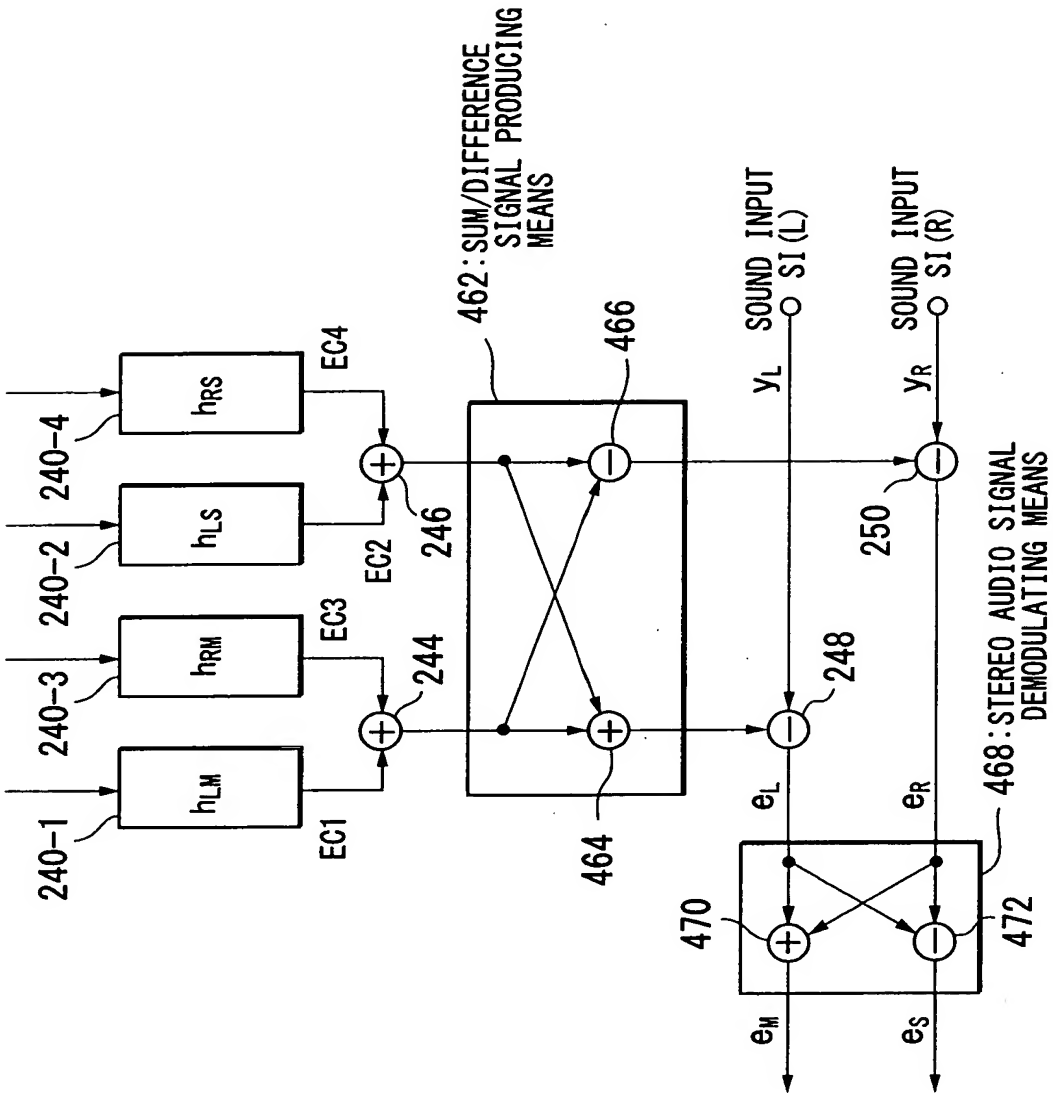

240-1
240-3
240-2
240-4
h_{LM}
h_{RM}
h_{LS}
h_{RS}
EC1
EC3
EC2
EC4
244
246
462: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
464
466
y_L SOUND INPUT SI(L)
y_R SOUND INPUT SI(R)
248
250
e_L
e_R
468: STEREO AUDIO SIGNAL DEMODULATING MEANS
470
472
e_M
e_S

FIG. 27

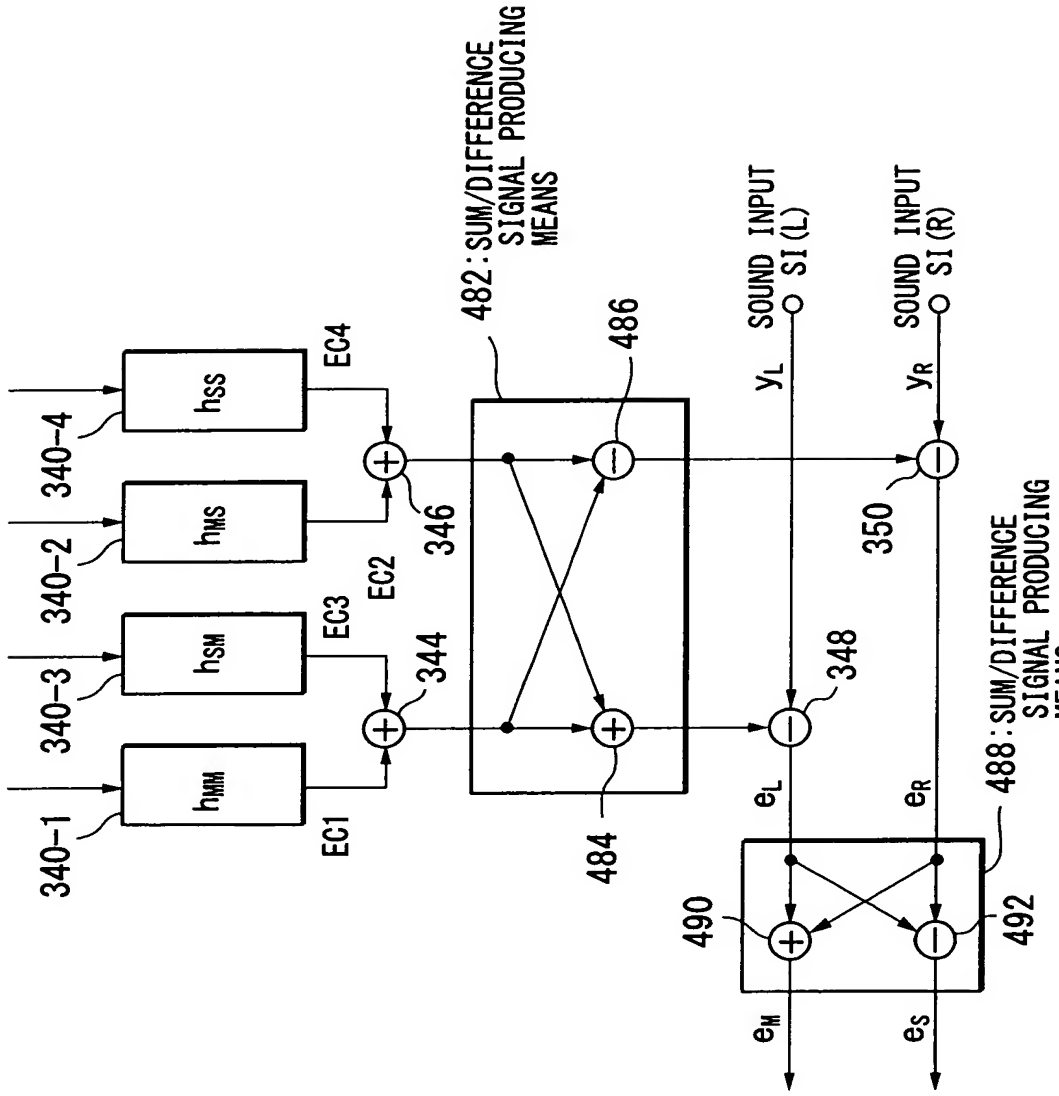

340-1
340-2
340-3
340-4
h_{MM}
h_{SM}
h_{MS}
h_{SS}
EC1
EC2
EC3
EC4
344
346
482: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
484
486
SOUND INPUT SI(L)
SOUND INPUT SI(R)
y_L
y_R
348
350
e_L
e_R
488: SUM/DIFFERENCE SIGNAL PRODUCING MEANS
490
492
e_M
e_S

FIG. 28

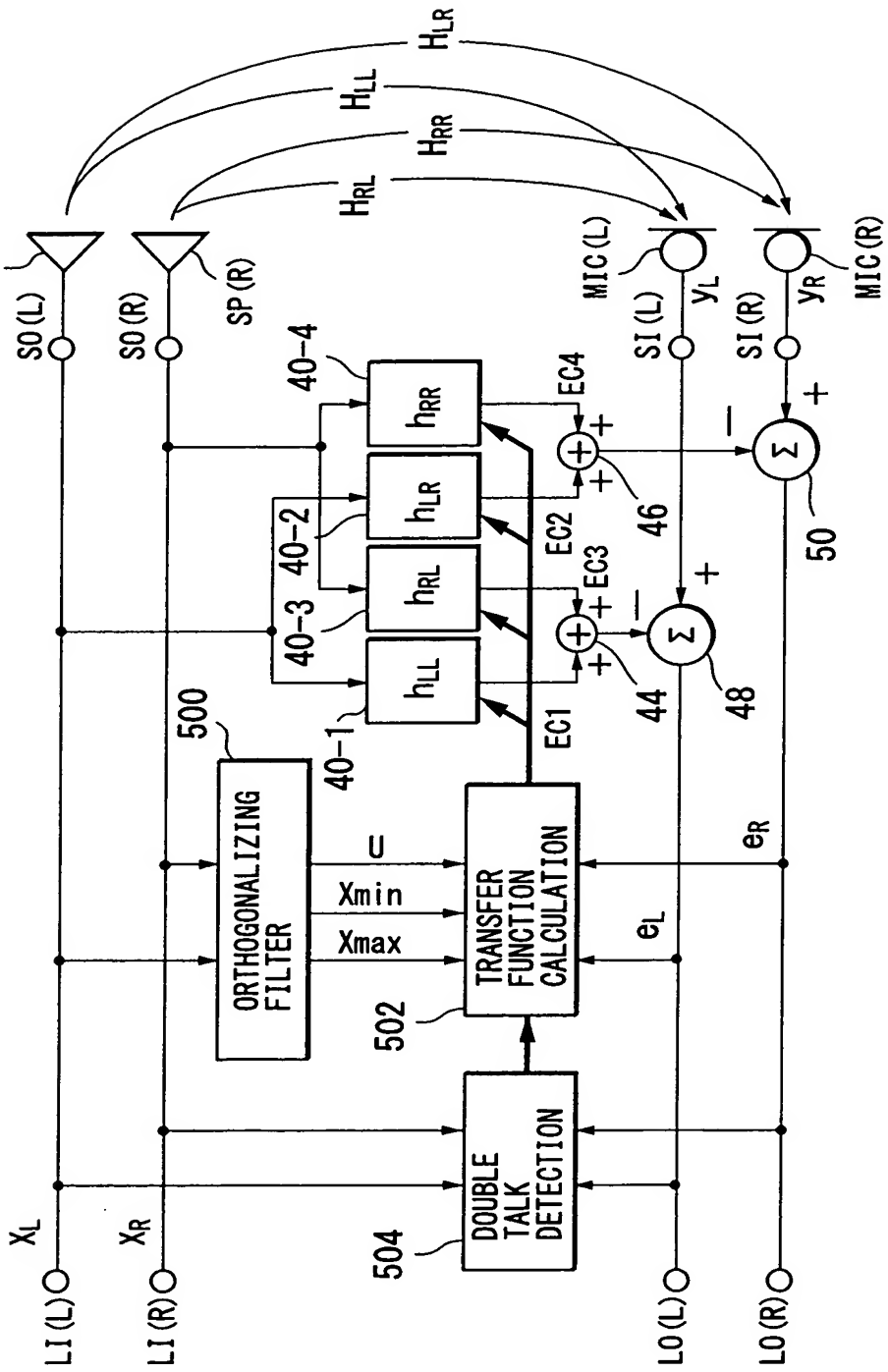

16, 24 : STEREO ECHO CANCELER
SP(L)
SP(R)
SO(L)
SO(R)
MIC(L)
MIC(R)
SI(L)
SI(R)
H_{LR}
H_{LL}
H_{RR}
H_{RL}
y_L
y_R
40-4
40-2
40-3
40-1
h_{RR}
h_{LR}
h_{RL}
h_{LL}
EC4
EC2
EC3
EC1
46
44
48
50
500
ORTHOGONALIZING FILTER
Xmin
Xmax
502
TRANSFER FUNCTION CALCULATION
e_R
e_L
504
DOUBLE TALK DETECTION
X_L
X_R
LI(L)
LI(R)
LO(L)
LO(R)

FIG. 29

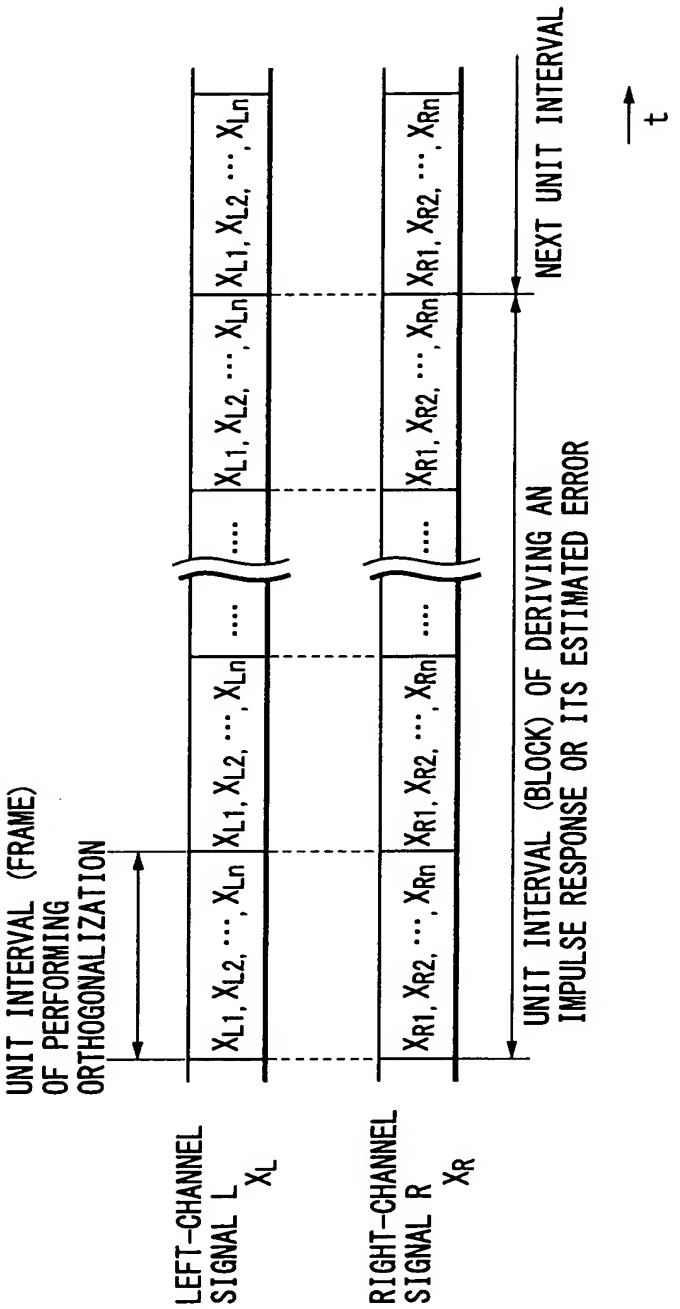

UNIT INTERVAL (FRAME)
OF PERFORMING
ORTHOGONALIZATION
LEFT-CHANNEL
SIGNAL L
X_L
RIGHT-CHANNEL
SIGNAL R
X_R
$X_{L1}, X_{L2}, \cdots, X_{Ln}$
$X_{R1}, X_{R2}, \cdots, X_{Rn}$
UNIT INTERVAL (BLOCK) OF DERIVING AN
IMPULSE RESPONSE OR ITS ESTIMATED ERROR
NEXT UNIT INTERVAL
t

FIG. 30

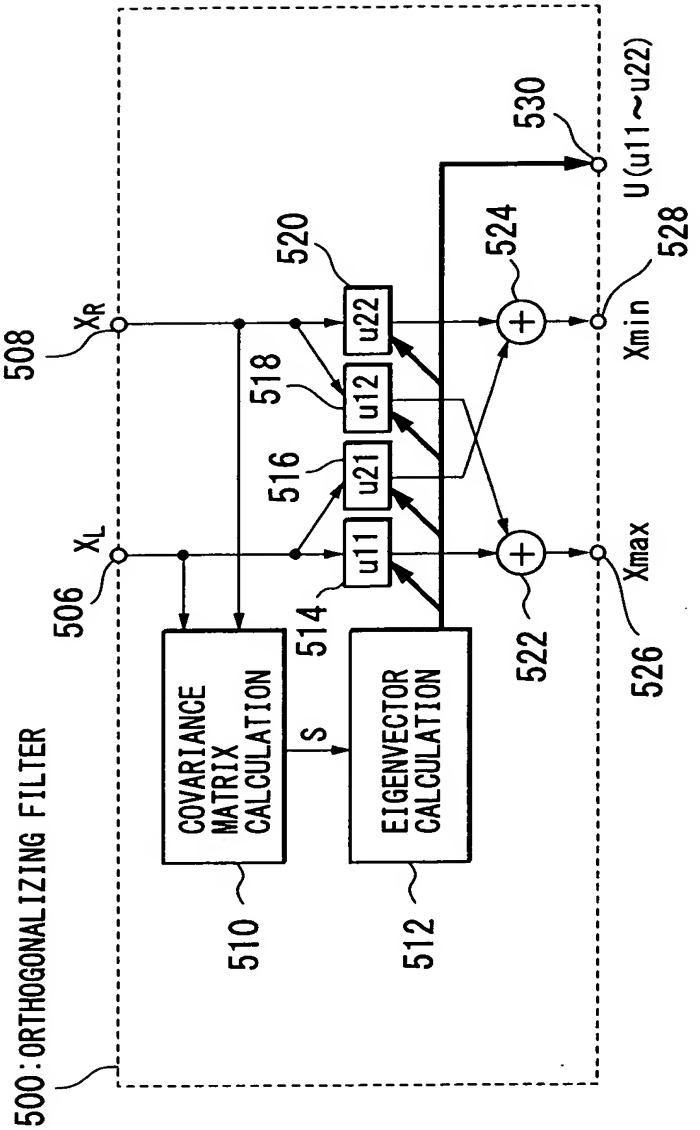

500:ORTHOGONALIZING FILTER
506
XL
508
XR
510
COVARIANCE MATRIX CALCULATION
S
512
EIGENVECTOR CALCULATION
514
u11
516
u21
518
u12
520
u22
522
524
526
Xmax
528
Xmin
530
U(u11~u22)

FIG. 31

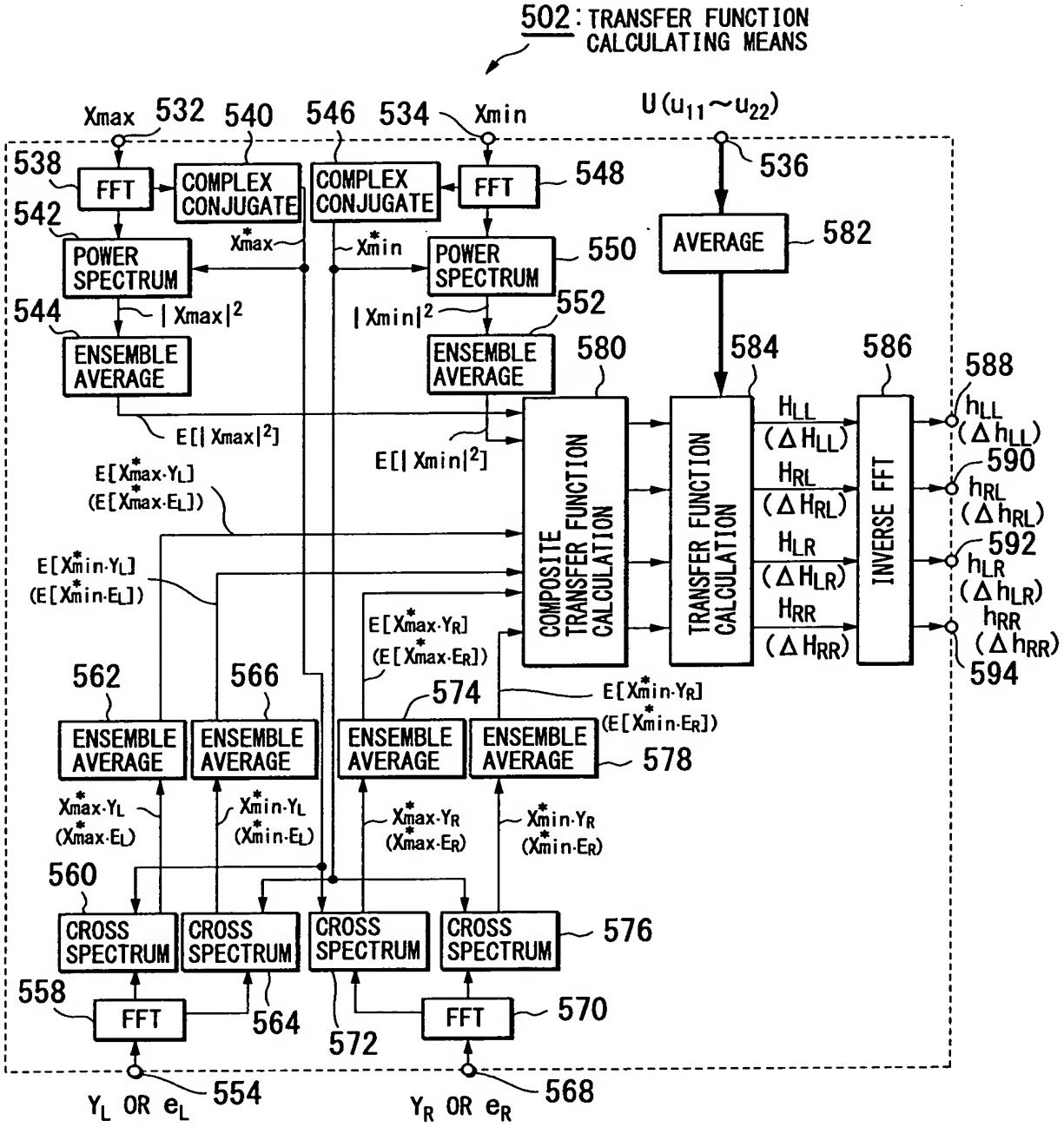

502: TRANSFER FUNCTION CALCULATING MEANS
Xmax
532
540
546
534
Xmin
U(u11~u22)
536
538
FFT
COMPLEX CONJUGATE
COMPLEX CONJUGATE
FFT
548
542
POWER SPECTRUM
X*max
X*min
POWER SPECTRUM
550
AVERAGE
582
544
|Xmax|2
|Xmin|2
552
ENSEMBLE AVERAGE
ENSEMBLE AVERAGE
580
584
586
588
E[|Xmax|2]
E[|Xmin|2]
E[X*max·YL]
(E[X*max·EL])
COMPOSITE TRANSFER FUNCTION CALCULATION
TRANSFER FUNCTION CALCULATION
HLL
(ΔHLL)
HRL
(ΔHRL)
HLR
(ΔHLR)
HRR
(ΔHRR)
INVERSE FFT
hLL
(ΔhLL)
590
hRL
(ΔhRL)
592
hLR
(ΔhLR)
hRR
(ΔhRR)
594
E[X*min·YL]
(E[X*min·EL])
E[X*max·YR]
(E[X*max·ER])
574
E[X*min·YR]
(E[X*min·ER])
562
566
ENSEMBLE AVERAGE
ENSEMBLE AVERAGE
ENSEMBLE AVERAGE
ENSEMBLE AVERAGE
578
X*max·YL
(X*max·EL)
X*min·YL
(X*min·EL)
X*max·YR
(X*max·ER)
X*min·YR
(X*min·ER)
560
CROSS SPECTRUM
CROSS SPECTRUM
CROSS SPECTRUM
CROSS SPECTRUM
576
558
FFT
564
572
FFT
570
YL OR eL
554
YR OR eR
568

FIG. 32

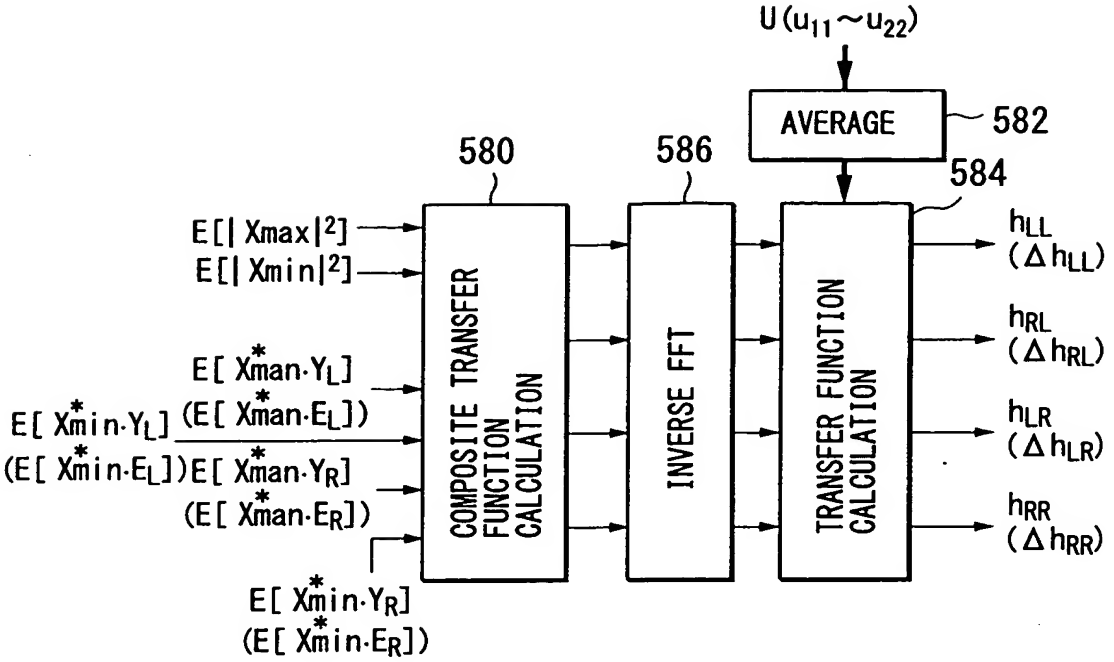

U(u11~u22)
AVERAGE
582
580
586
584
E[|Xmax|2]
E[|Xmin|2]
E[X*man·YL]
(E[X*man·EL])
E[X*min·YL]
(E[X*min·EL])
E[X*man·YR]
(E[X*man·ER])
E[X*min·YR]
(E[X*min·ER])
COMPOSITE TRANSFER FUNCTION CALCULATION
INVERSE FFT
TRANSFER FUNCTION CALCULATION
hLL (ΔhLL)
hRL (ΔhRL)
hLR (ΔhLR)
hRR (ΔhRR)

FIG. 33

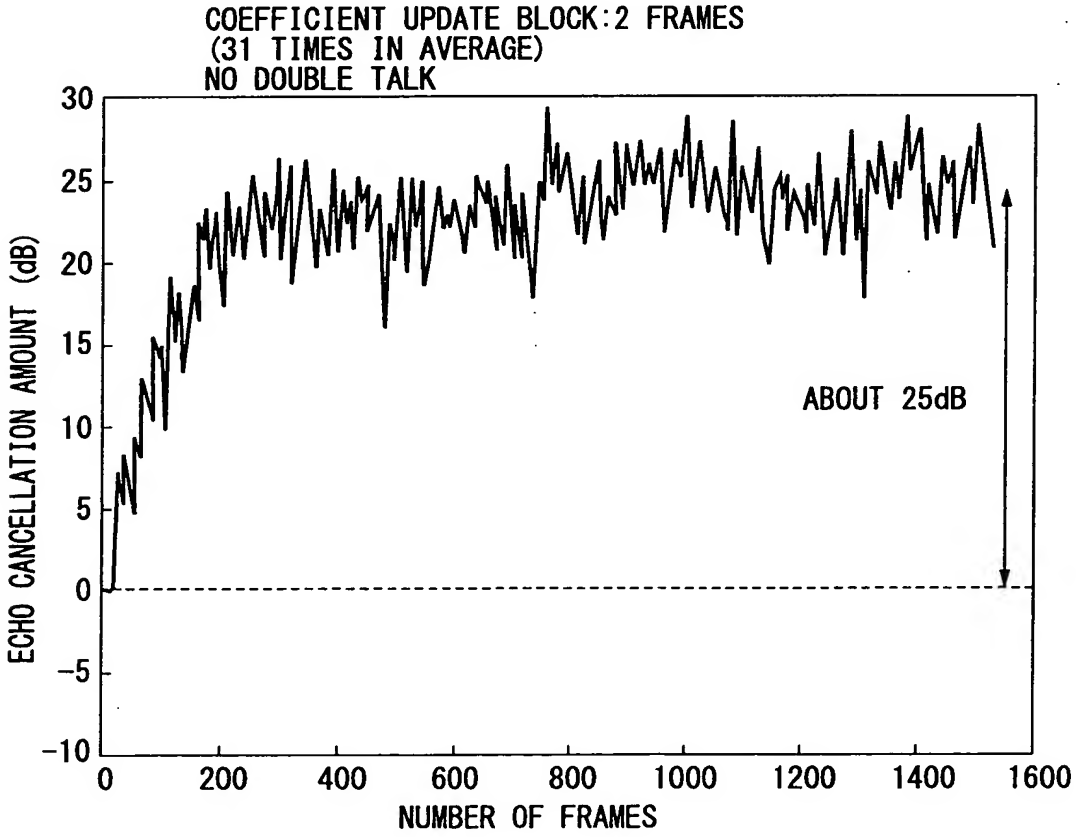

COEFFICIENT UPDATE BLOCK:2 FRAMES
(31 TIMES IN AVERAGE)
NO DOUBLE TALK
ECHO CANCELLATION AMOUNT (dB)
30
25
20
15
10
5
0
-5
-10
0
200
400
600
800
1000
1200
1400
1600
NUMBER OF FRAMES
ABOUT 25dB

FIG.34

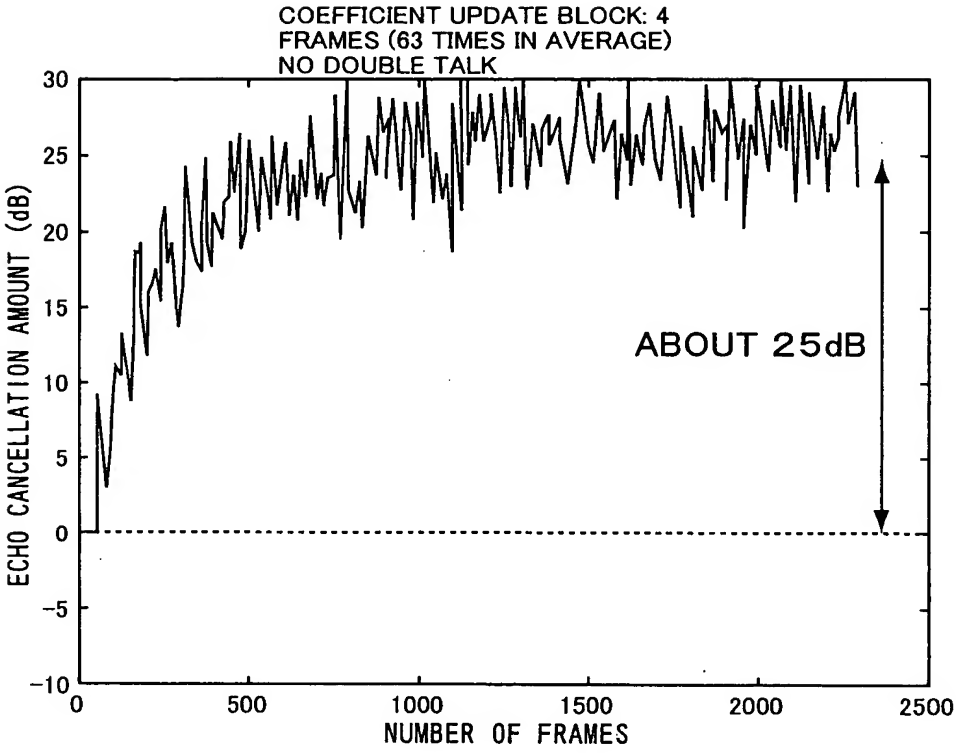

COEFFICIENT UPDATE BLOCK: 4
FRAMES (63 TIMES IN AVERAGE)
NO DOUBLE TALK
ECHO CANCELLATION AMOUNT (dB)
30
25
20
15
10
5
0
-5
-10
0
500
1000
1500
2000
2500
NUMBER OF FRAMES
ABOUT 25dB

FIG.35

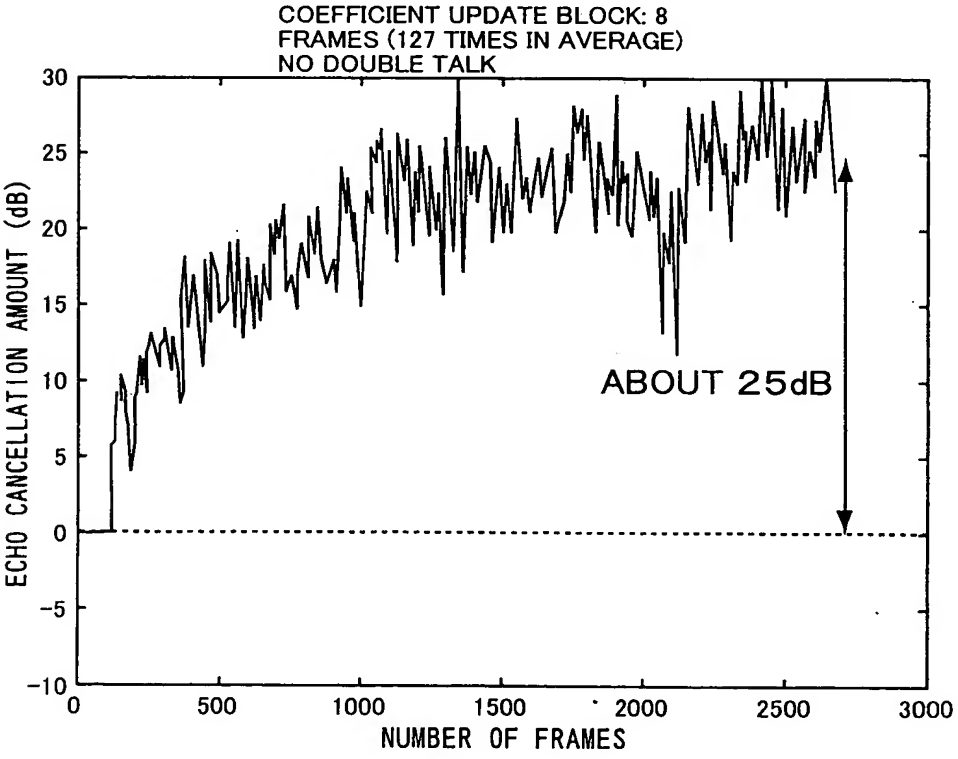

COEFFICIENT UPDATE BLOCK: 8
FRAMES (127 TIMES IN AVERAGE)
NO DOUBLE TALK
ECHO CANCELLATION AMOUNT (dB)
30
25
20
15
10
5
0
-5
-10
0
500
1000
1500
2000
2500
3000
NUMBER OF FRAMES
ABOUT 25dB

FIG.36

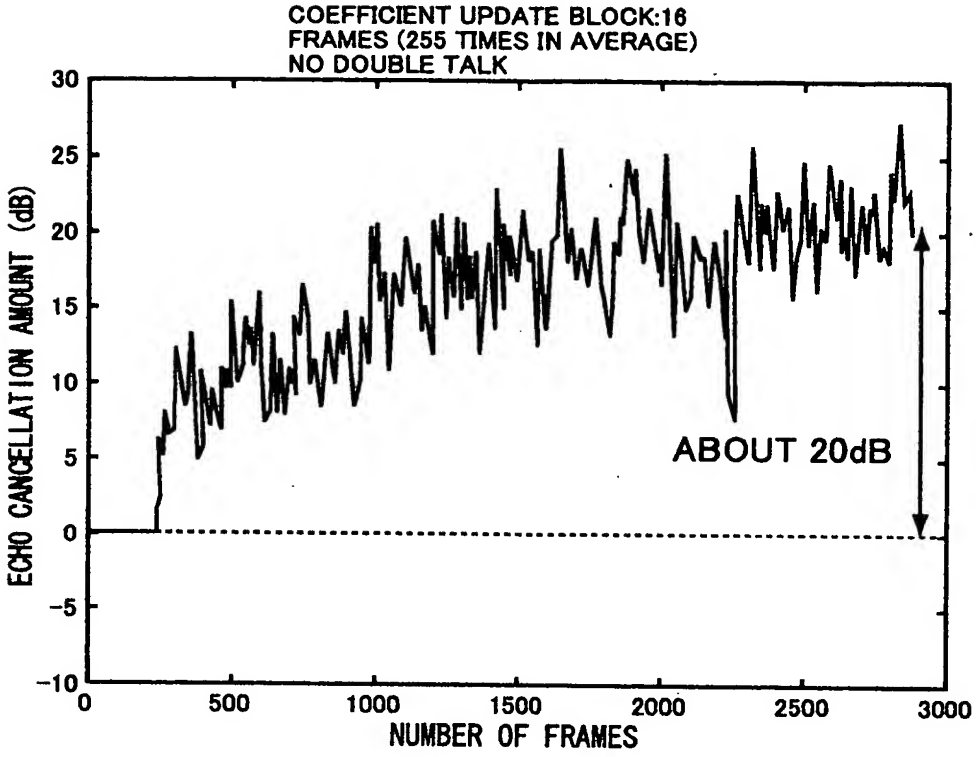

COEFFICIENT UPDATE BLOCK:16
FRAMES (255 TIMES IN AVERAGE)
NO DOUBLE TALK
ECHO CANCELLATION AMOUNT (dB)
NUMBER OF FRAMES
ABOUT 20dB
30
25
20
15
10
5
0
-5
-10
0
500
1000
1500
2000
2500
3000

FIG.37

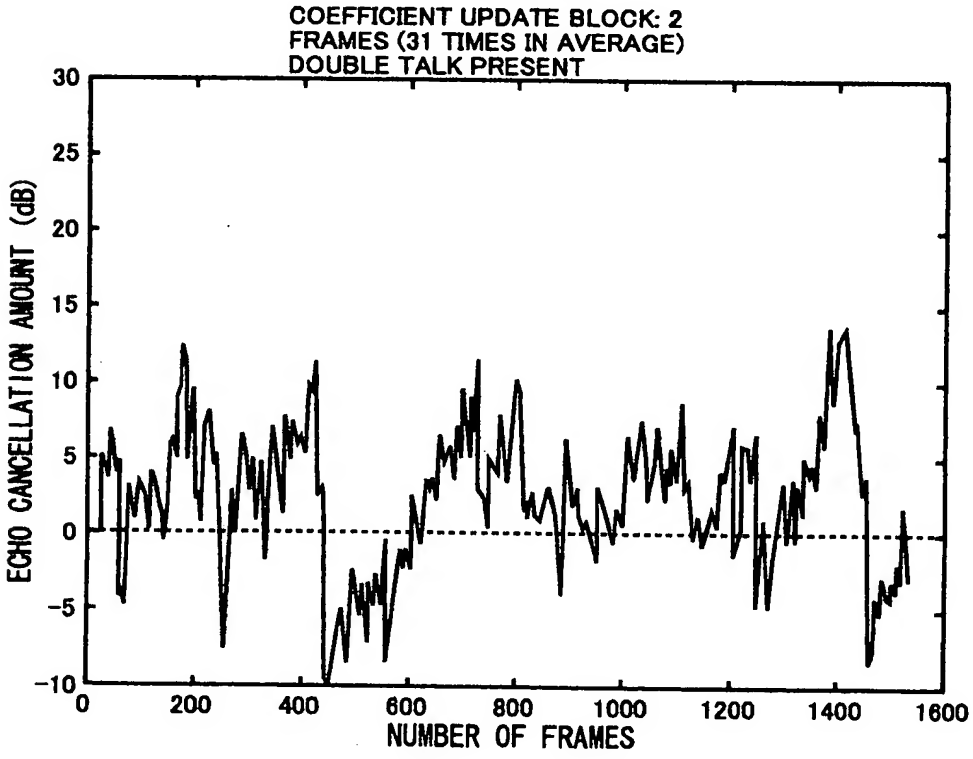

COEFFICIENT UPDATE BLOCK: 2
FRAMES (31 TIMES IN AVERAGE)
DOUBLE TALK PRESENT
ECHO CANCELLATION AMOUNT (dB)
NUMBER OF FRAMES
30
25
20
15
10
5
0
-5
-10
0
200
400
600
800
1000
1200
1400
1600

FIG.38

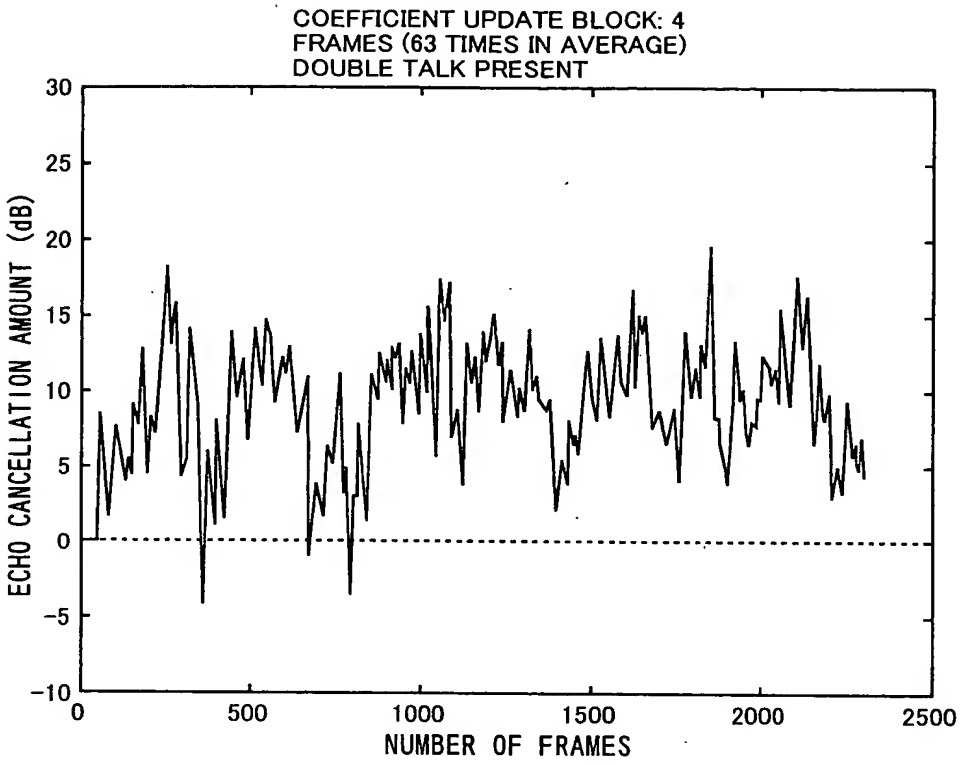

COEFFICIENT UPDATE BLOCK: 4
FRAMES (63 TIMES IN AVERAGE)
DOUBLE TALK PRESENT
ECHO CANCELLATION AMOUNT (dB)
30
25
20
15
10
5
0
-5
-10
0
500
1000
1500
2000
2500
NUMBER OF FRAMES

FIG.39

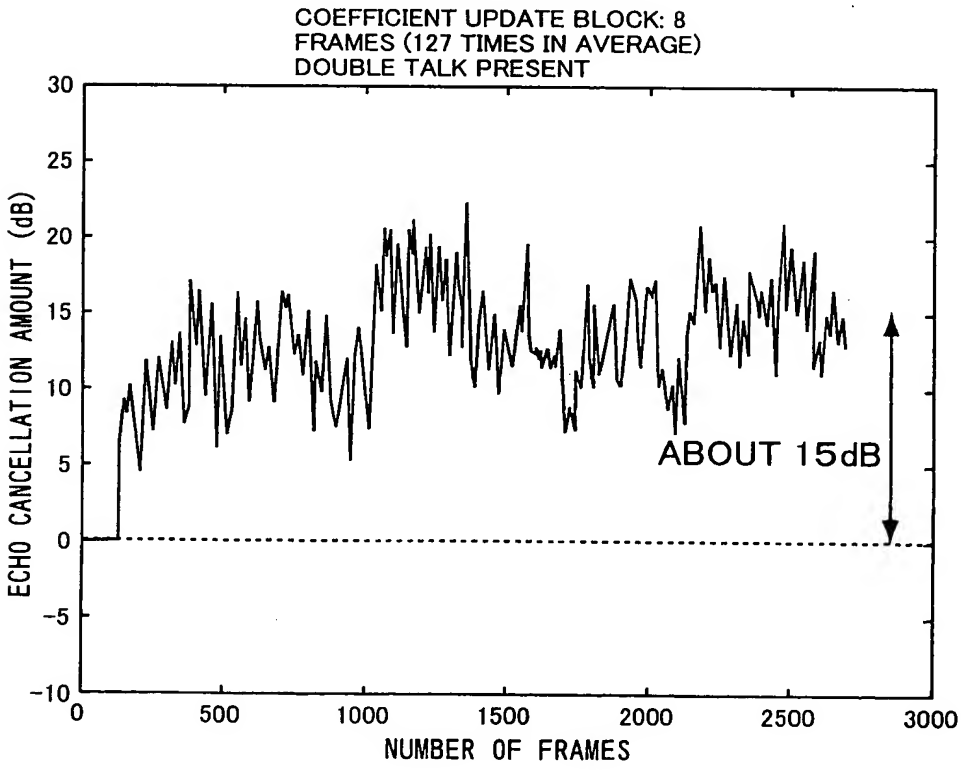

COEFFICIENT UPDATE BLOCK: 8
FRAMES (127 TIMES IN AVERAGE)
DOUBLE TALK PRESENT
ECHO CANCELLATION AMOUNT (dB)
30
25
20
15
10
5
0
-5
-10
0
500
1000
1500
2000
2500
3000
NUMBER OF FRAMES
ABOUT 15dB

FIG.40

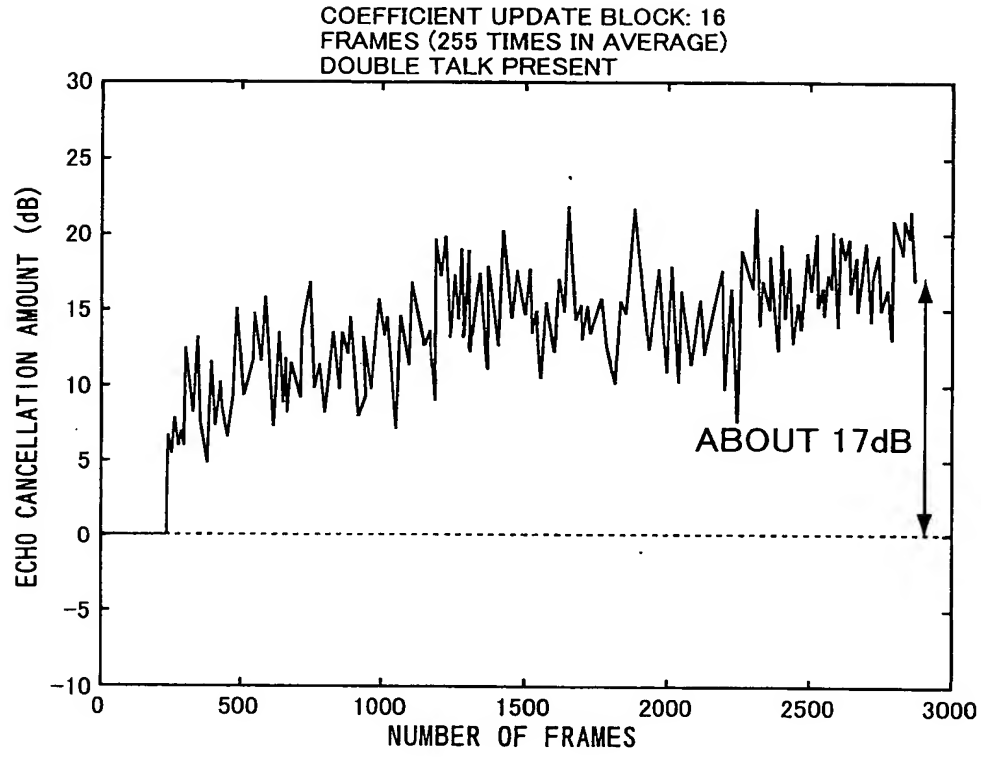

COEFFICIENT UPDATE BLOCK: 16
FRAMES (255 TIMES IN AVERAGE)
DOUBLE TALK PRESENT
ECHO CANCELLATION AMOUNT (dB)
30
25
20
15
10
5
0
-5
-10
0
500
1000
1500
2000
2500
3000
NUMBER OF FRAMES
ABOUT 17dB

FIG.41

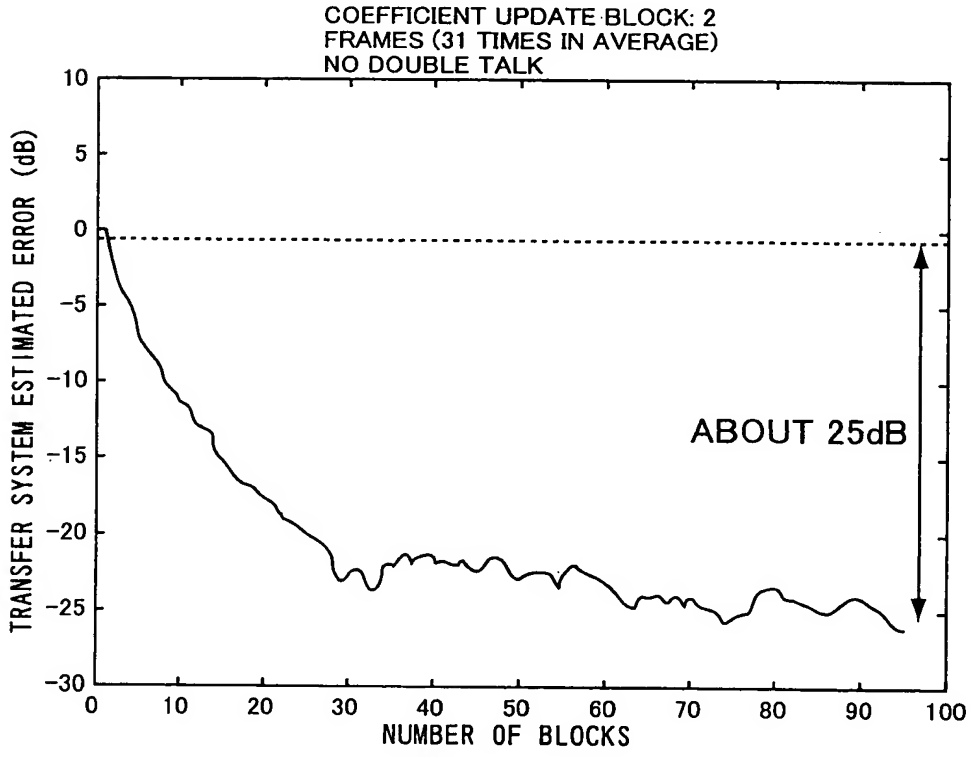

COEFFICIENT UPDATE BLOCK: 2
FRAMES (31 TIMES IN AVERAGE)
NO DOUBLE TALK
TRANSFER SYSTEM ESTIMATED ERROR (dB)
10
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
70
80
90
100
NUMBER OF BLOCKS
ABOUT 25dB

FIG.42

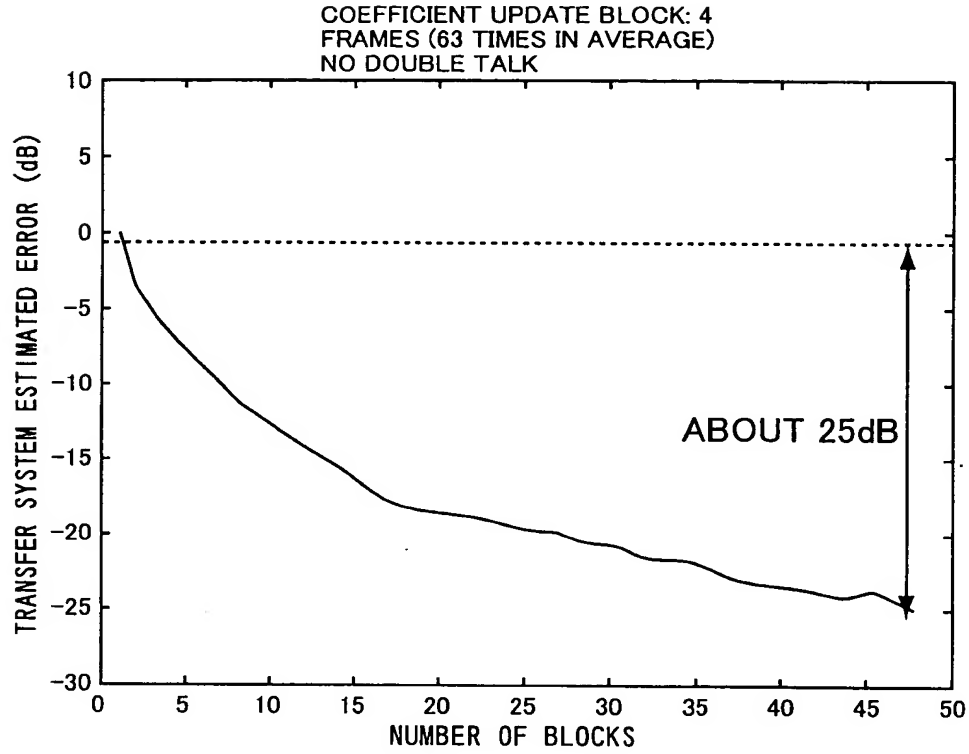

COEFFICIENT UPDATE BLOCK: 4
FRAMES (63 TIMES IN AVERAGE)
NO DOUBLE TALK
TRANSFER SYSTEM ESTIMATED ERROR (dB)
10
5
0
-5
-10
-15
-20
-25
-30
0
5
10
15
20
25
30
35
40
45
50
NUMBER OF BLOCKS
ABOUT 25dB

FIG.43

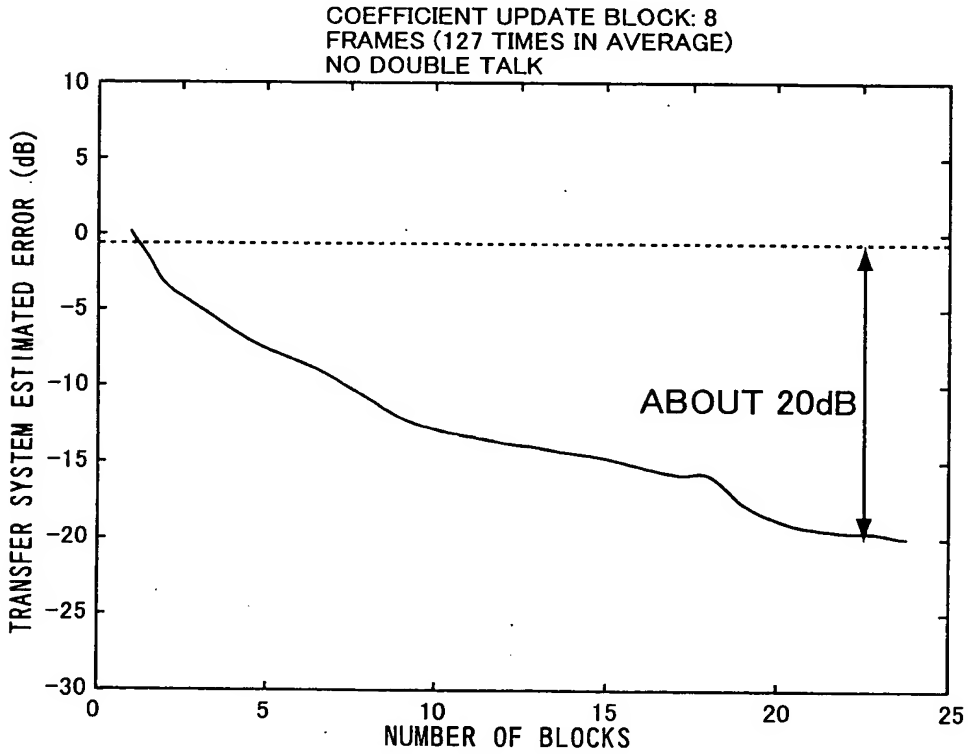

COEFFICIENT UPDATE BLOCK: 8
FRAMES (127 TIMES IN AVERAGE)
NO DOUBLE TALK
TRANSFER SYSTEM ESTIMATED ERROR (dB)
10
5
0
-5
-10
-15
-20
-25
-30
0
5
10
15
20
25
NUMBER OF BLOCKS
ABOUT 20dB

FIG.44

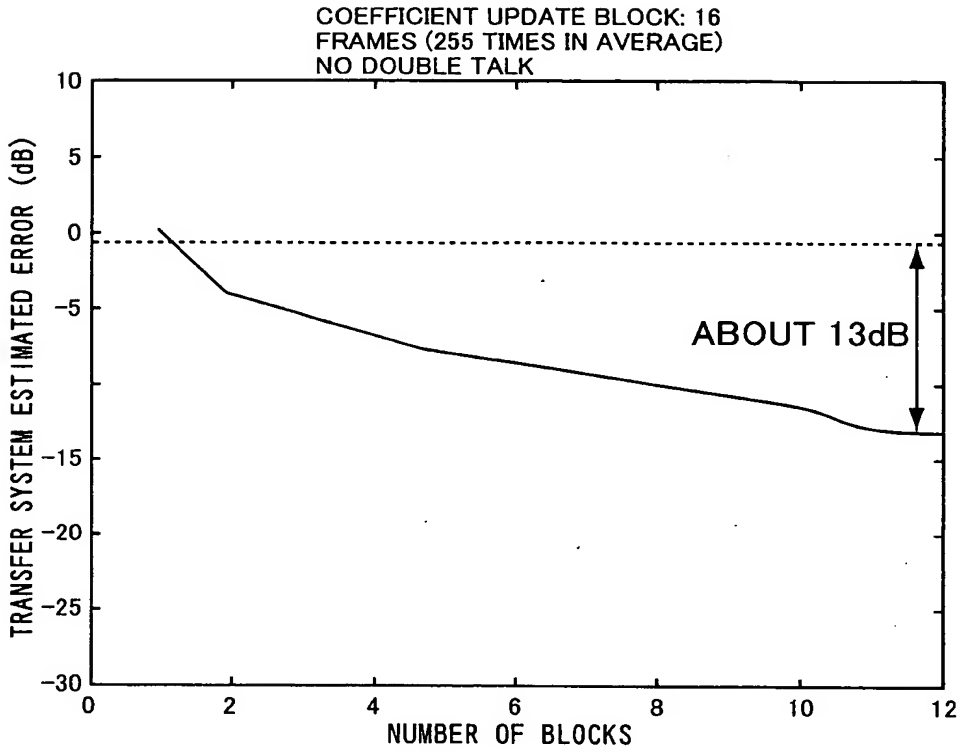

COEFFICIENT UPDATE BLOCK: 16
FRAMES (255 TIMES IN AVERAGE)
NO DOUBLE TALK
TRANSFER SYSTEM ESTIMATED ERROR (dB)
10
5
0
-5
-15
-20
-25
-30
ABOUT 13dB
0
2
4
6
8
10
12
NUMBER OF BLOCKS

FIG.45

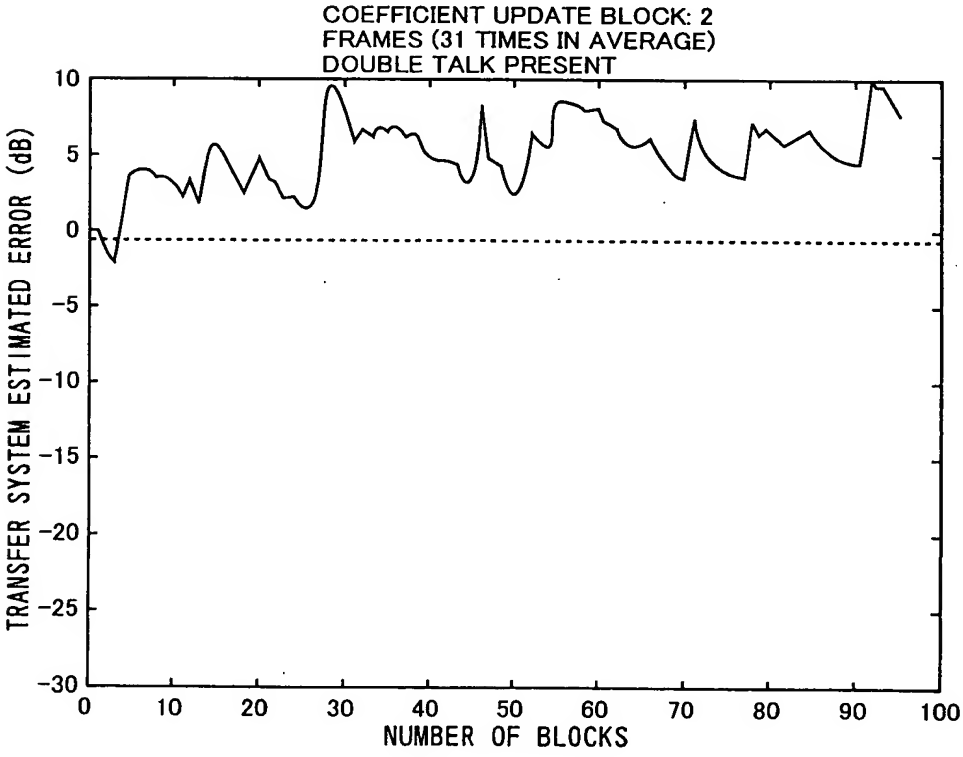

COEFFICIENT UPDATE BLOCK: 2
FRAMES (31 TIMES IN AVERAGE)
DOUBLE TALK PRESENT
TRANSFER SYSTEM ESTIMATED ERROR (dB)
10
5
0
-5
-10
-15
-20
-25
-30
0
10
20
30
40
50
60
70
80
90
100
NUMBER OF BLOCKS

FIG.46

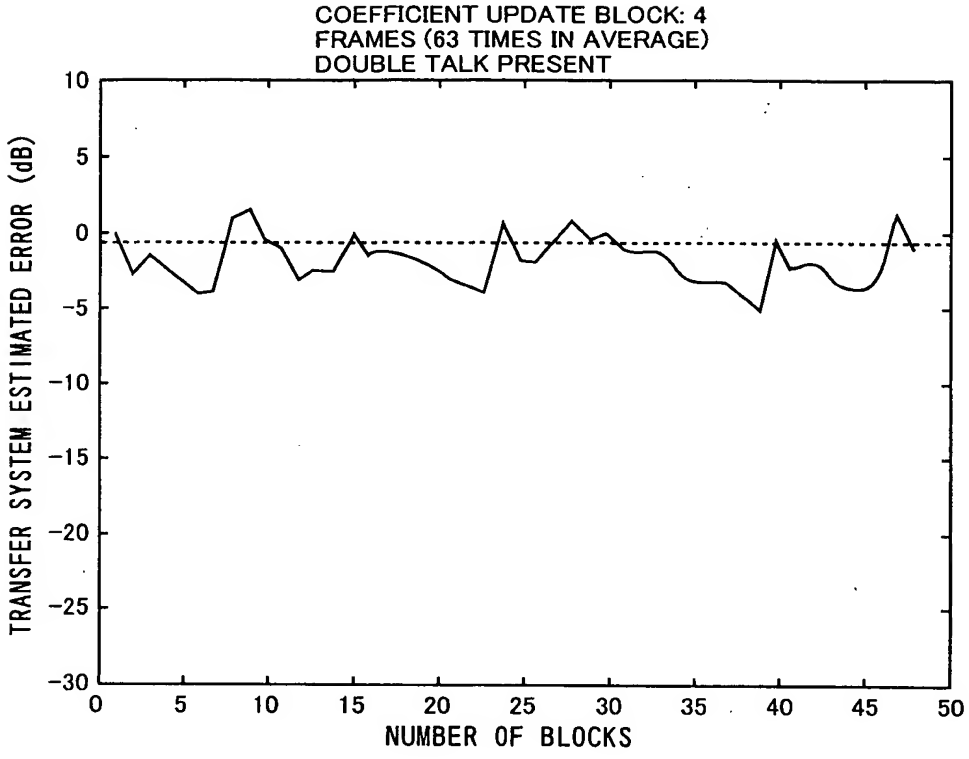

COEFFICIENT UPDATE BLOCK: 4
FRAMES (63 TIMES IN AVERAGE)
DOUBLE TALK PRESENT
TRANSFER SYSTEM ESTIMATED ERROR (dB)
10
5
0
-5
-10
-15
-20
-25
-30
0
5
10
15
20
25
30
35
40
45
50
NUMBER OF BLOCKS

FIG.47

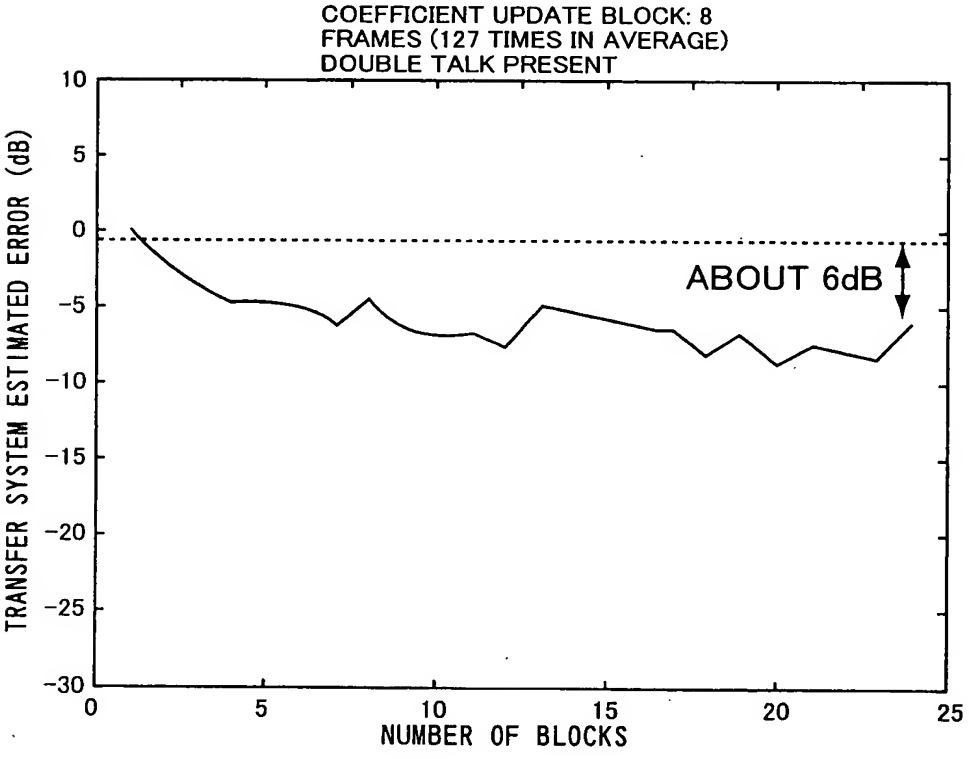

COEFFICIENT UPDATE BLOCK: 8
FRAMES (127 TIMES IN AVERAGE)
DOUBLE TALK PRESENT
TRANSFER SYSTEM ESTIMATED ERROR (dB)
10
5
0
-5
-10
-15
-20
-25
-30
ABOUT 6dB
0
5
10
15
20
25
NUMBER OF BLOCKS

FIG.48

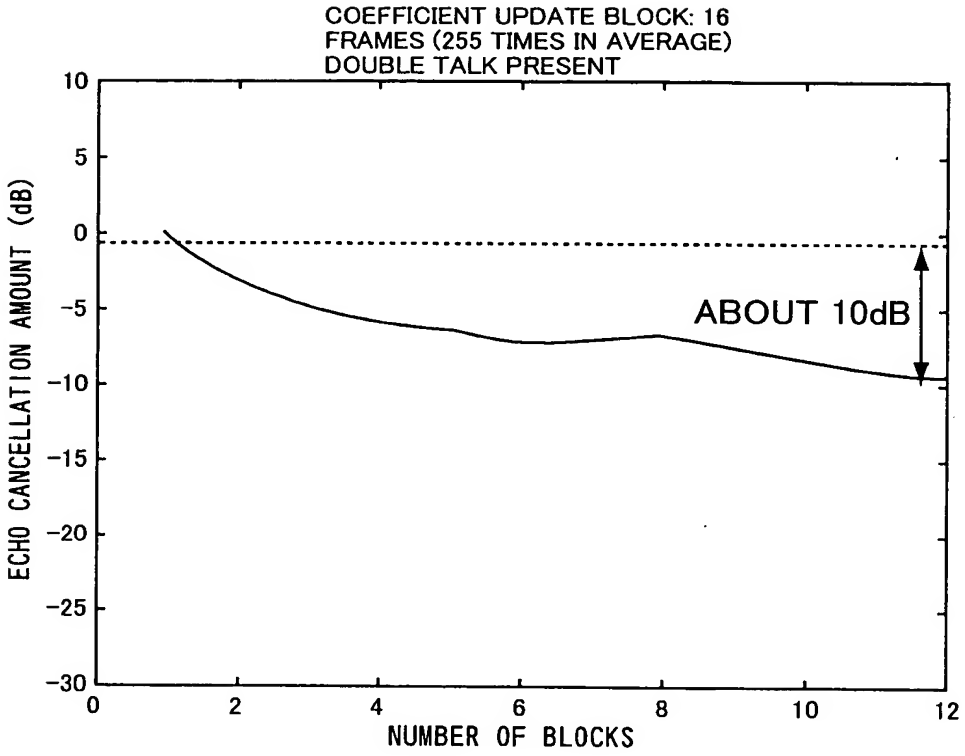

COEFFICIENT UPDATE BLOCK: 16
FRAMES (255 TIMES IN AVERAGE)
DOUBLE TALK PRESENT
ECHO CANCELLATION AMOUNT (dB)
10
5
0
-5
-10
-15
-20
-25
-30
ABOUT 10dB
0
2
4
6
8
10
12
NUMBER OF BLOCKS

FIG. 49

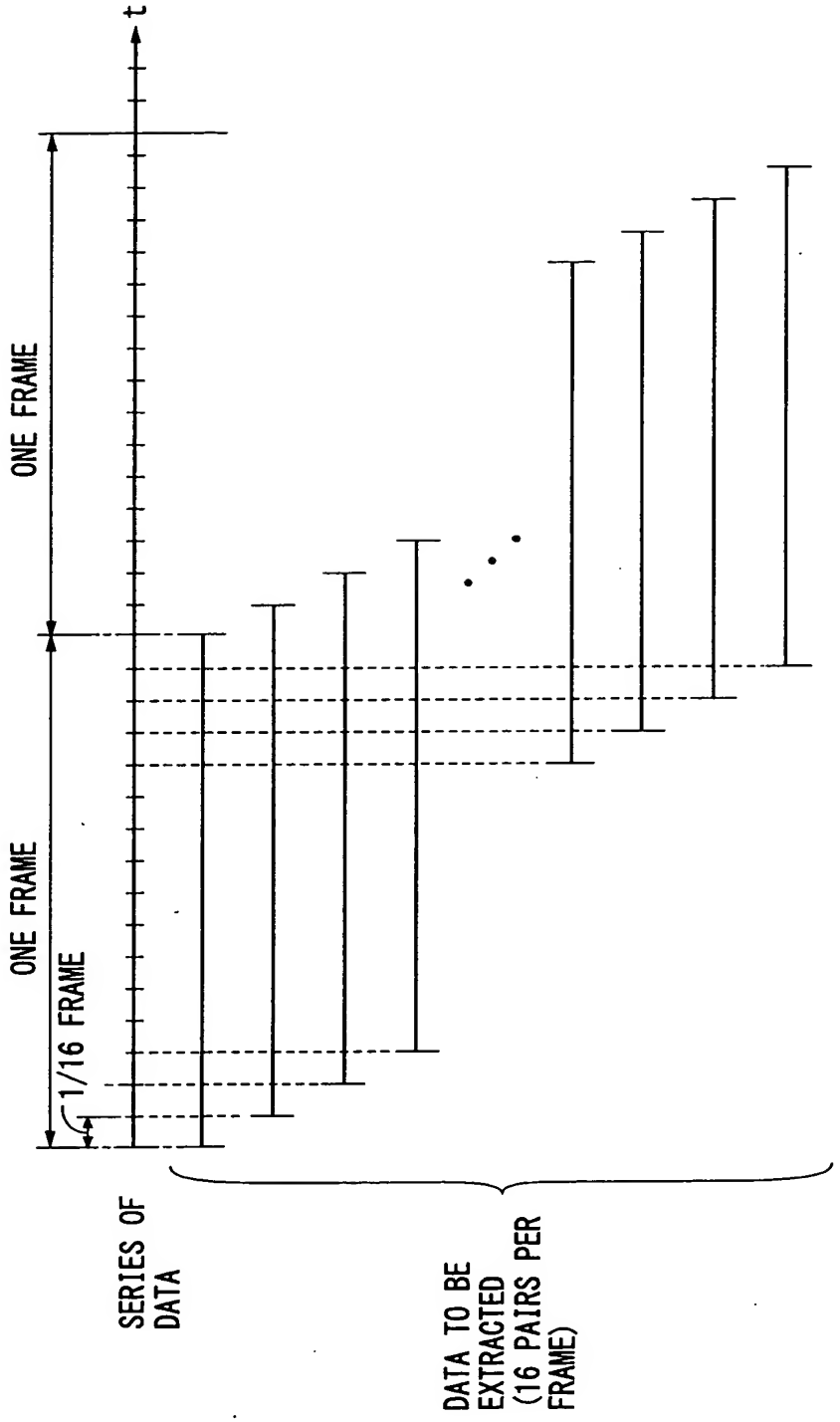

t
ONE FRAME
ONE FRAME
1/16 FRAME
SERIES OF DATA
DATA TO BE EXTRACTED (16 PAIRS PER FRAME)

FIG. 50

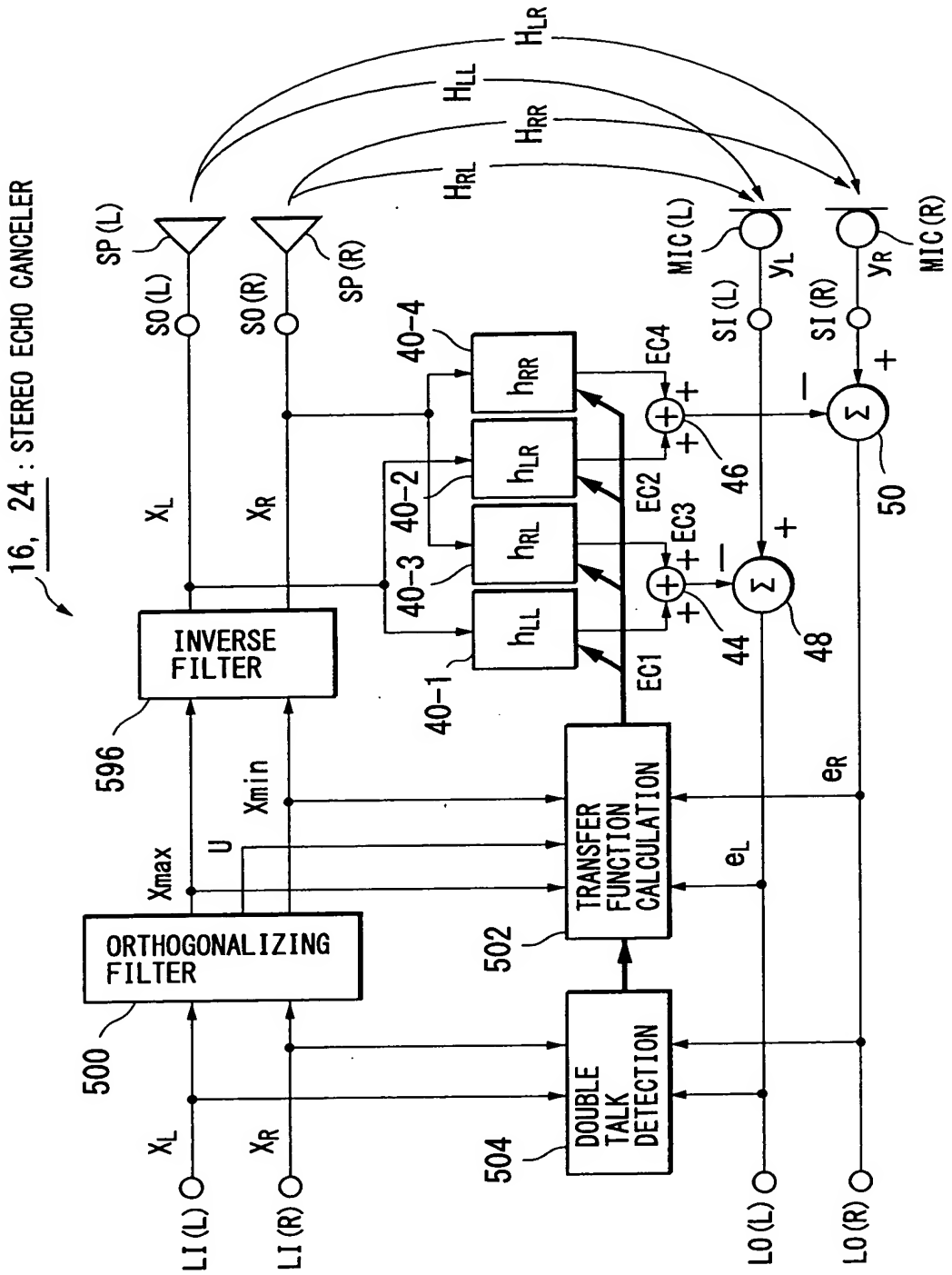
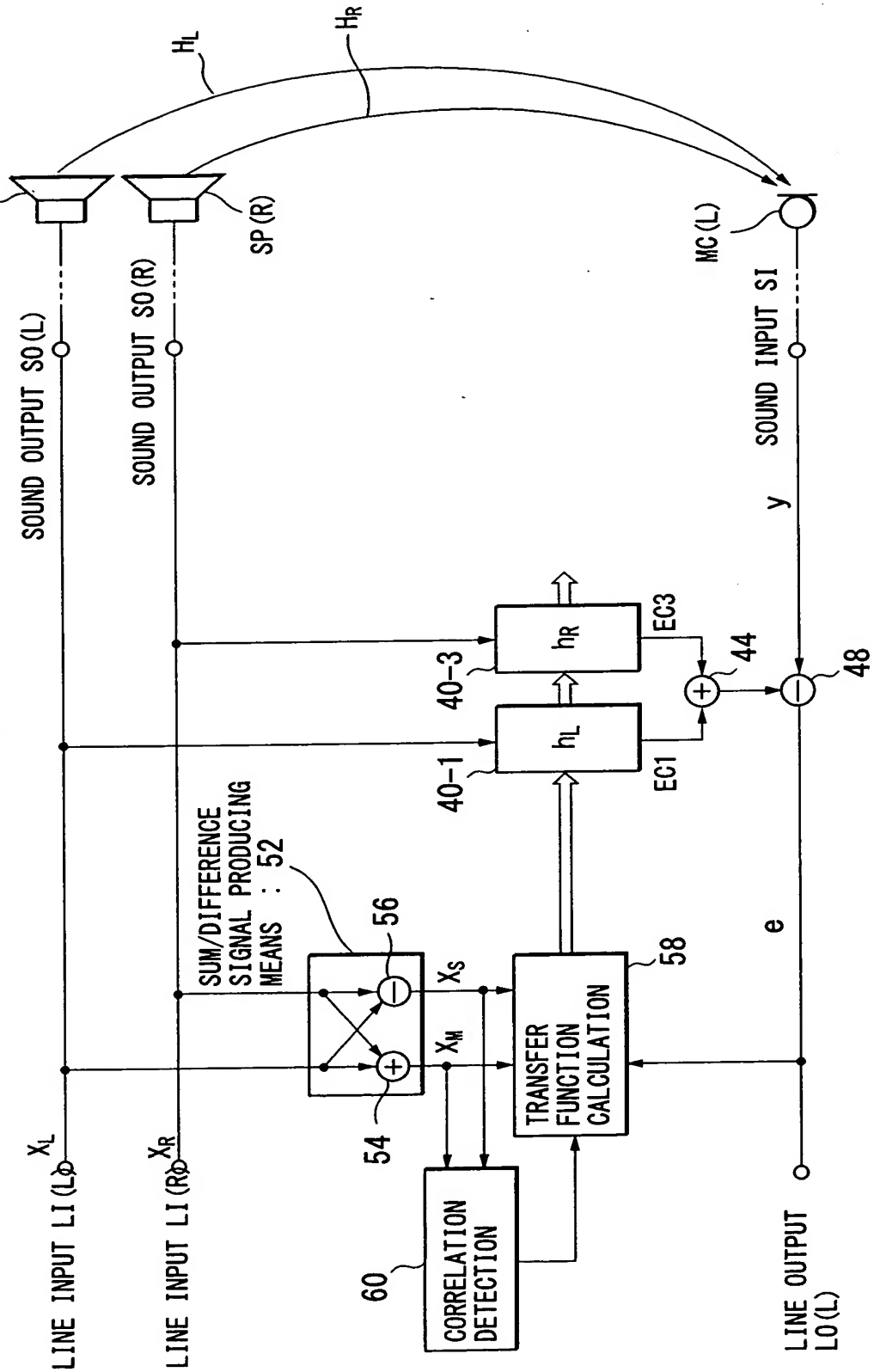

16, 24 : STEREO ECHO CANCELER
SP(L)
SP(R)
SO(L)
SO(R)
MIC(L)
MIC(R)
SI(L)
SI(R)
H_{LR}
H_{LL}
H_{RR}
H_{RL}
y_L
y_R
x_L
x_R
40-4
40-2
40-3
40-1
h_{RR}
h_{LR}
h_{RL}
h_{LL}
EC4
EC2
EC3
EC1
46
44
48
50
INVERSE FILTER
596
Xmin
Xmax
U
ORTHOGONALIZING FILTER
500
TRANSFER FUNCTION CALCULATION
502
DOUBLE TALK DETECTION
504
e_R
e_L
LI(L)
LI(R)
LO(L)
LO(R)

FIG. 51


16, 24 : STEREO ECHO CANCELER
SP(L)
SP(R)
H_L
H_R
MC(L)
SOUND OUTPUT SO(L)
SOUND OUTPUT SO(R)
SOUND INPUT SI
y
h_R
h_L
40-3
40-1
EC3
EC1
44
48
SUM/DIFFERENCE SIGNAL PRODUCING MEANS : 52
56
54
X_S
X_M
58
TRANSFER FUNCTION CALCULATION
e
60
CORRELATION DETECTION
X_L
X_R
LINE INPUT LI(L)
LINE INPUT LI(R)
LINE OUTPUT LO(L)